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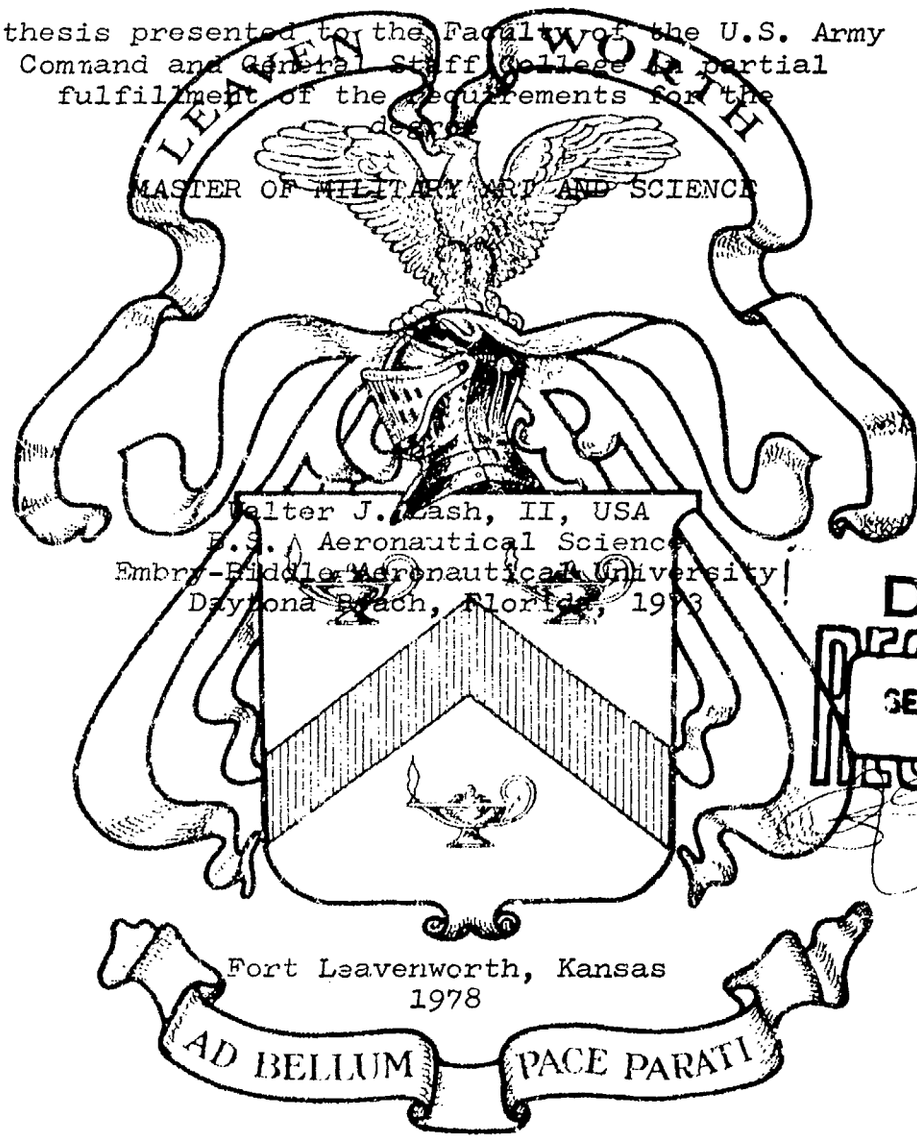
LEVEL II

HARDWARE REQUIREMENTS FOR HELICOPTER AIR-TO-AIR WEAPONS IN THE 1980'S

A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

MASTER OF MILITARY ART AND SCIENCE



Walter J. Lash, II, USA
B.S., Aeronautical Science
Embry-Riddle Aeronautical University
Daytona Beach, Florida, 1973

Fort Leavenworth, Kansas
1978

78 08 11 039

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Hardware Requirements for Helicopter Air-to-Air Weapons in the 1980s		5. TYPE OF REPORT & PERIOD COVERED Final Report 9 June 1978 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Lash, Walter J. II, MAJ, USA		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Student at the U.S. Army Command and General Staff College, Fort Leavenworth, Kansas 66027		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Command & General Staff College. ATTN: ATSW-SE FT. LEAVENWORTH, KANSAS 66027		12. REPORT DATE 9 June 1978 13. NUMBER OF PAGES 107 Unclas., 45 Clas.
14. MONITORI[illegible] ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. *(of this report)* Unclassified w/classified appendix 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT *(of this Report)* Distribution limited to U.S. Government Agencies only; proprietary information. 9 JUN 1978 Distribution limited to U.S. Gov't. agencies only; Proprietary Info.; 9 JUN 1978. Other requests for this document must be referred to		
17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)* Weapons, Helicopter, Air-to-Air Weapons		
20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

In view of the Soviet's advancement in combat helicopters, it is clear that a need exists for a self-defense capability for U.S. helicopters. This thesis examines the current Soviet threat, the current direction in developing and fielding an air-to-air weapon system and the emphasis in helicopter employment and operations in the NATO environment.

As part of the growing lethality of the battlefield, aircraft survivability equipment is also examined to validate their need in this environment, as well as assess their impact on self-defense weapons. This survivability equipment is required for helicopters to operate within the significant air defense network portrayed, and their development must be carefully monitored to compliment the aircraft weapons systems.

This thesis recommends the integration of a family of weapons (guns, TOW and STINGER) on the Attack and Scout Helicopter that would collectively and mutually counter the Soviet threat. The air-to-air weapons in the 1980s must be capable of more than a single role, and both guns and missile must be developed to operate in various modes and interface with air-to-surface weapons requirements. In view of the critical role of the Attack Helicopter Team, a family of weapons which provide mutual support to one another is the only realistic approach to this problem. But one fact remains, the lack of an effective air-to-air system must be corrected immediately, and future systems must evolve from the current development programs underway. That is, of course, if the United States Army wishes to remain the world leader in helicopter operations.

(6) HARDWARE REQUIREMENTS FOR HELICOPTER AIR-TO-AIR WEAPONS IN THE 1980s.

(10) WALTER J. LASH, II [redacted]
U.S. ARMY COMMAND AND GENERAL STAFF COLLEGE
FORT LEAVENWORTH, KANSAS 66027

(11) 9 Jan 78

(9) Final report, [redacted]

(12) 115 p.

9 Jan 78

A Master of Military Art and Science thesis presented to the faculty of the U.S. Army Command and General Staff College, Fort Leavenworth, Kansas 66027

MASTER OF MILITARY ART AND SCIENCE

THESIS APPROVAL PAGE

Name of candidate WALTER J. LASH, II, MAJ, FA

Title of thesis Hardware Requirements for Helicopter Air-to-Air Weapons in the 1980's

Approved by:

_____, Research Advisor

_____, Member, Graduate Faculty

_____, Member, Graduate Faculty

_____, Member, Consulting Faculty

Accepted this 23rd day of May 1978 by _____, Director, Master of Military Art and Science.

The opinions and conclusions expressed herein are those of the individual student author and do not necessarily represent the views of either the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

In view of the Soviet's advancement in combat helicopters, it is clear that a need exists for a self-defense capability for U.S. helicopters. This thesis examines the current Soviet threat, the current direction in developing and fielding an air-to-air weapon system and the emphasis in helicopter employment and operations in the NATO environment.

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CHAPTER I

INTRODUCTION

The extensive use of helicopters on the battlefield is a direct reflection of their ability to destroy the enemy. This was validated in Vietnam and Cambodia, where attack helicopters became the primary weapons against armor forces. In Southeast Asia there was no need or threat to produce weapons to combat an enemy air threat. However, in Europe the situation will be very different, air superiority will be constantly changing and the air threat will be the greatest single non-nuclear military advancement since World War II.

Since the early 1960's, the United States Armed Forces have been making greater use of helicopters in their operations. Besides the transport and liaison roles, helicopters equipped with various weapons systems are more and more assigned active roles in ground combat operations. The Soviet Union has been very perceptive of this new capability and has made great advances in their attack helicopter programs. The result of this is the Hind-A attack helicopter which provides multicapabilities to the Soviet Front Commander and, in turn, has become one of the many threats which now faces U.S. Forces. During both defensive and

offensive employment, the Hind-A, armed with antitank missiles, rockets, and guns can provide more firepower than current Army aviation assets.

It is anticipated that in the future, Soviet forces will make greater use of the airmobile assault. These assaults will make maximum use of weather, terrain and day/night operationing conditions. To improve troop training with helicopters, current training doctrine emphasizes that ground combat efforts be combined with increased mobility and flexibility. Because of this, the heliborne assaults, often used in conjunction with paratrooper operations, are becoming important features of the Soviet doctrine in the high-speed offense. Additionally, armed reconnaissance missions are conducted by Soviet helicopters in the advanced guard role. This role is vital to fix and locate concentrated forces so artillery or ground forces can be employed effectively, often this employment may be nothing more than avoiding heavily held areas. Bypassing an engagement allows Soviet forces to drive deep into the enemy's rear area thus allowing the Soviet Second Echelon Forces to isolate and destroy bypassed enemy resistance. During the attack, air assault operations may be conducted as flanking, rear area or bridge-held assaults to gain the advantage by surprise.

With this additional Soviet air capability, the U.S. Air Defense System will engage these targets based on weapons availability and weapons capability. This is nothing

more than proper management of limited resources to achieve the maximum results. The real dilemma arises when considering the maneuverability, fleeting nature and low altitude environments of the helicopter in comparison to the limited capabilities of air defense weapons against these tactics.

A thesis by Major Robert C. Knight, addressing the requirement for an air-to-air defense capability for attack helicopters, states:

> The most effective system to defeat the attack helicopter threat is a system which can operate under the same weather conditions, over the same terrain, have the same characteristics concerning flight maneuverability, and, most importantly, have the appropriate weapon to engage and destroy the enemy.[1]

Major Knight's analysis provides the basis for growing arguments and debates in considering the best way to destroy a helicopter. Aviation proponents point to the trends in helicopter warfare throughout the world, particularly with significant increases in mobility and lethality of helicopters systems. These improvements will influence the attack helicopters role on the battlefield and the very presence of an equal enemy helicopter threat will place this role in jeopardy. The use of an air-to-air weapon on a helicopter would insure uninterrupted access to the battle and provide a mobile air defense umbrella for helicopter

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[1]Robert C. Knight, "Air-to-Air Defense For Attack Helicopters," (Thesis, Master of Military Art and Science, U.S. Army Command and General Staff College, 1976), p. 32.

forces. The ability to destroy a maneuvering helicopter will depend on the weather and terrain it is operating in and more importantly, the altitude, speed and maneuverability it is capable of achieving. This environment can only be negotiated effectively by another helicopter, one which is specifically equipped with an air-to-air weapon.

The realization of the prospect of an anti-helicopter has increased interest in providing an appropriate air-to-air system and has urged other interests in air-to-surface weapons against anti-aircraft systems. It must be stated that these systems provide an inherent battlefield requirement for self-defense, offensive employment of an air-to-air weapon is not consistent with the current mission of Army aviation.

The overall impact and significance of this potential of attack helicopters in an anti-helicopter role remains to be completely evaluated. However, the subject of the development and exploitation of new weapons should be viewed as suggested by Major General John H. Cushman:

> When a time of fundamental change comes in the art of war, a great prize goes to the military institution with the perception to see that a time of great change has come, with the wisdom to see its outlines, with the creativity to exploit technology and human inventiveness to meet the new conditions, and with the leadership--and good luck--to bring about constructive change.[2]

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[2]Department of the Army, U.S. Army Command and General Staff College, Profession of Arms, Course 9000 (FY 1974-75), p. AS-6-1-11, Quoting MG John H. Cushman.

At present, research and experimentation are being conducted to immediately field a system which will meet the requirements of an effective air-to-air weapon. Many factors will have direct implications in terms of the final product, and all must be carefully evaluated. One such factor is the development of passive defensive systems such as radar warning receivers, infra-red jammers and missile launch/approach detectors. Another factor which will influence the final product is current and proposed helicopter operations and employment in support of U.S. Forces. Critical changes are now taking place in heliborne doctrine and will provide the basis for helicopter employment in the 1980's. However, the most significant factor to be examined will be the perceived threat against our forces. Opinions vary, but seem to indicate that a Soviet-United States War is unlikely, but one fact remains, the Soviets supply vast amounts of weapons to other countries and the likelihood of their employment against the United States is very high. All of these factors will bear directly on the final weapon and will serve to justify their development.

The hardware which will be produced must be compatible with all systems and subsystems designed to support the attack helicopter and not detract from its anti-armor mission. The term "hardware" includes the air-to-air weapon system, as well as, fire control systems and armament subsystems and the development of these systems and

subsystems with current technology and available weapons will provide the basis for the air-to-air weapon which will evolve in the 1980's.

STATEMENT OF THE PROBLEM

What will be the hardware requirements for a helicopter air-to-air weapon system by the mid-1980's? Specifically, do we need a two missile concept, a missile and gun approach, or ultimately, a one missile multi-role capability?

PURPOSE OF THE STUDY

The specific purpose of this research is to make a significant contribution to the process of research and development for a completely new family of weapons which will serve the needs of our future fighting forces. An underlying aim of this effort is to provide a margin of survivability to those who will fight in an increasingly lethal environment.

Until recently, little emphasis has been placed on the feasibility of helicopters engaging each other on the battlefield. Now Army Aviation training has begun to incorporate active and passive countermeasures against threat aircraft, including helicopters. With this admission of realistic possibilities we need to consider what types of weapon systems need to be incorporated into our

helicopter fleet. It is to this problem that this thesis is directed.

METHODOLOGY

The basic method for evaluating the hardware requirements of an air-to-air system was through research of available documents and current experiments. Research was conducted in the facilities of the U.S. Army Command and General Staff College Library and the Aerial Systems Branch, U.S. Army Combined Arms Combat Development Activity. The Defense Documentation Center Terminal proved very useful in identifying documents pertaining to the research requirement, particularly background reading and information relating to aerial weapons and aerial combat simulations.

The evaluation of current data was accomplished with the guidance and expertise of the Aerial Systems Branch, CACDA. Without their assistance this undertaking could not have been possible.

ORGANIZATION OF REMAINDER OF THESIS

Subsequent chapters are organized topically as follows:

Chapter II	Threat
Chapter III	Helicopter Operations
Chapter IV	Passive Defensive Systems
Chapter V	Active Defensive Systems

This thesis addresses the helicopter as an integral part of U.S. Forces, the need for protecting this asset and the systems necessary for its survival.

Chapter II surveys the enemy threat to helicopter operations, from both the high speed aircraft and combat helicopter. This chapter will establish the likelihood of helicopter aerial engagements and the need to provide a defensive weapon.

Chapter III examines current and proposed helicopter operations of the U.S. Army. This examination reveals that the U.S. Army will continue to place great emphasis on helicopter tactics and employment.

Chapter IV reviews the passive defensive systems available to the helicopter fleet. This review will show survivability as one aspect of total defensive needs.

Chapter V traces the current efforts to develop and field an air-to-air weapon system. Weapon systems available will be examined and will include missiles and guns.

Chapter VI will discuss the finding of this author. Several scenarios will be discussed and modifications to helicopter doctrine will be considered.

Chapter VII summarizes this study and presents the author's conclusions and recommendations.

CHAPTER II

THE AIR THREAT

This chapter will examine the air-to-air threat which could confront U.S. Forces in the event war occurred. The examination will address high speed aircraft, the attack helicopter and the employment of each in Soviet Doctrine. The effectiveness of these weapons can only be estimated, since many factors will have direct bearing as to their capabilities. Such factors include air superiority, anti-aircraft weapons, weather conditions, just to name a few. Therefore, this examination will consider only the air threat as it would apply to helicopter operations of the U.S. Army.

High speed aircraft can be equipped with a variety of weapons systems, including bombs, rockets, missiles and automatic cannons. This fact clearly places Soviet fighter aircraft among potential helicopter adversaries. But, because of the various weapon systems, generally aircraft are designed and employed along standard mission criteria. This, simply stated, insures that a fighter designed for a certain role would not or possibly could not perform in another role. An air-to-air interceptor designed for speeds in excess of twice the speed of sound will not be able to safely slow to the speeds a helicopter normally operates.

Additionally, the turning radius of high speed aircraft tends to enlarge their paths over the ground, making it very difficult to observe an elusive target, such as a helicopter.

The normal airspace in which high speed aircraft operate, varies from 1,000 feet upward in excess of 40,000 feet. In order for helicopters to survive the battlefield it must operate between one foot to 100 feet. Therefore, by design and operation, high speed aircraft are not employed in an anti-helicopter role. That is not to say that fighter aircraft would not engage a helicopter or fleet of helicopters, but it is not a suitable weapon for that particular role. It would be like taking a hammer to a fly, you would have tremendous overkill, if and only if you were fortunate enough to hit it.

The single tactical high speed aircraft mission which poses the greatest threat to helicopter operations is the armed reconnaissance mission. "The Soviets place great emphasis on air reconnaissance, primarily because of the mobility characteristics of modern military forces which cause rapidly changing target location and priorities."[1] "Armed reconnaissance is defined as a planned air mission flown with the primary purpose of searching out, attacking,

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[1]U.S. Army Intelligence Threat Analysis Detachment, USAITAD Report No. 14-U-76, Military Operations of the Soviet Army, 25 May 1976, p. 230.

and destroying targets of opportunity."[2] Helicopters can expect to be engaged by aircraft conducting this type of mission.

The Soviet MIG-21 Fishbed and SU-7 Fitter (Figure A), are currently replacing older aircraft used in the ground attack role. This aircraft is standard in more than 20 air forces throughout the world. Depending on the models, both aircraft may be used for reconnaissance, air-to-air, and ground support missions. The MIG-21 can be armed with 240 millimeter air-to-surface missiles, 1,100 pound bombs, 57 millimeter rockets or 23 millimeter guns, all in various combinations. (Specifications, Figure B and B-1)

The types of attack this high speed aircraft could use to engage a helicopter are strafing, bombing, or a rocket attack. We may expect the Soviets to adopt tactics similar to our own employment of such weaponry. "Cannon fire (strafing) is a basic weapon of the fighter aircraft. Strafing is easily performed and may be initiated from almost any condition of flight with a minimum of preplanning. The fact that the normal dive angle is 5° to 45° makes strafing a highly effective method of attack against helicopters."[3] Bombing and rocket attacks, on the other

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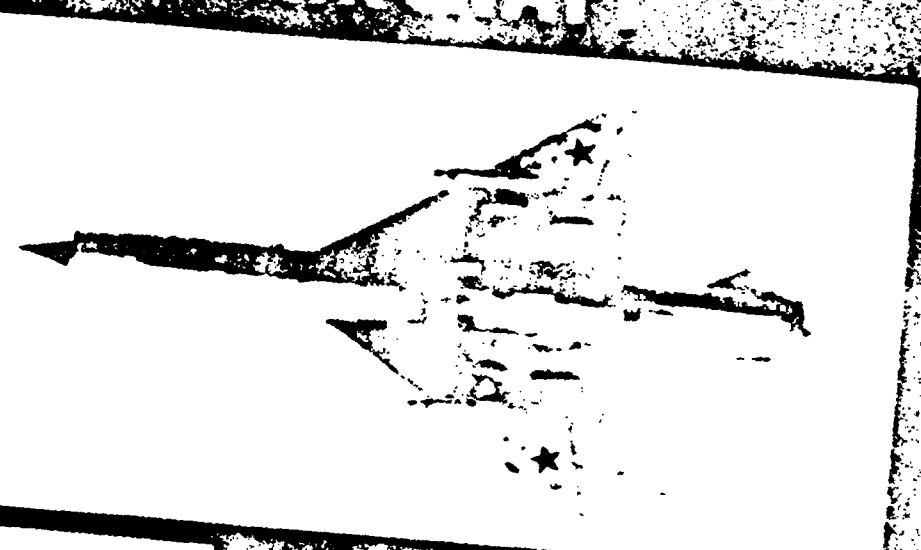
[2]U.S. Army Aviation School, Field Manual 90-1, Employment of Army Aviation Units in a High Threat Environment, 30 September 1976, p. 2-13.

[3]Ibid.

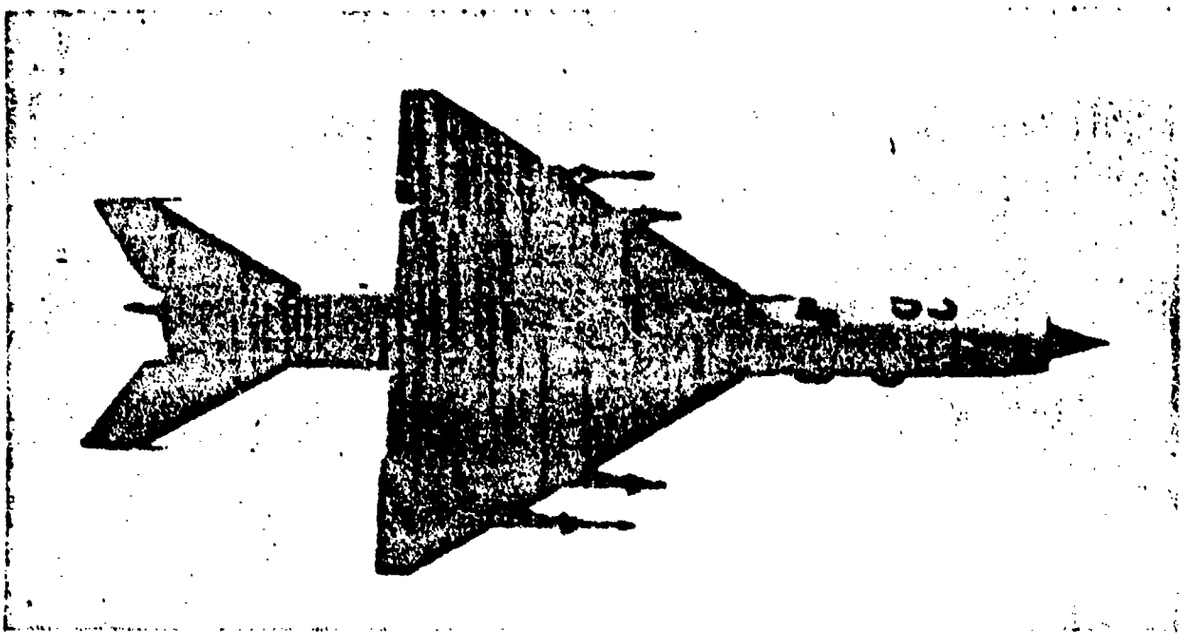
TACTICAL AIRCRAFT

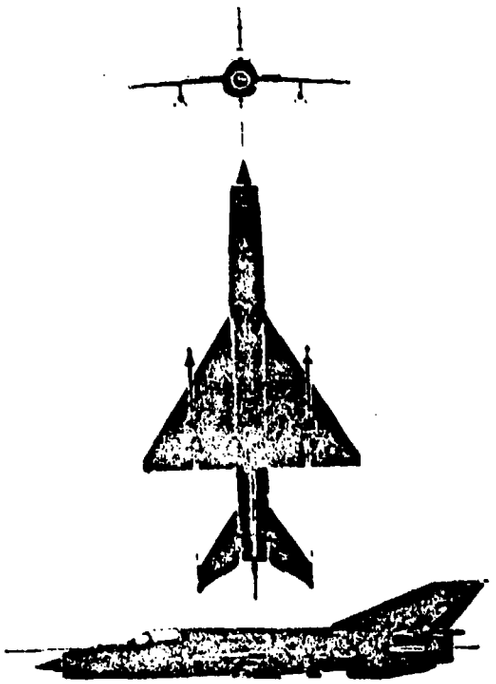
MIG-21



SU-7

Figure A. The MIG 21 FISHBED and the SU-7 FITTER





The Mig-21 FISHBED is a single-seat, clear-weather, jet fighter/interceptor aircraft manufactured in the USSR, India, and the People's Republic of China. This aircraft is in service with the Soviet Air Force and in most Sino-Soviet satellite nations.

Dimensions and Performance:

Wingspan	24 feet (7 meters)
Length	40 feet (12 meters)
Maximum speed	1,400 mph (Mach 2) (1,215 knots)
Maximum range	700 nautical miles
Service ceiling	60,000 feet

Recognition Features:

a. Slightly downward slanting, midmounted delta wings with small, square tips. Early versions have three wing fences on each wing.

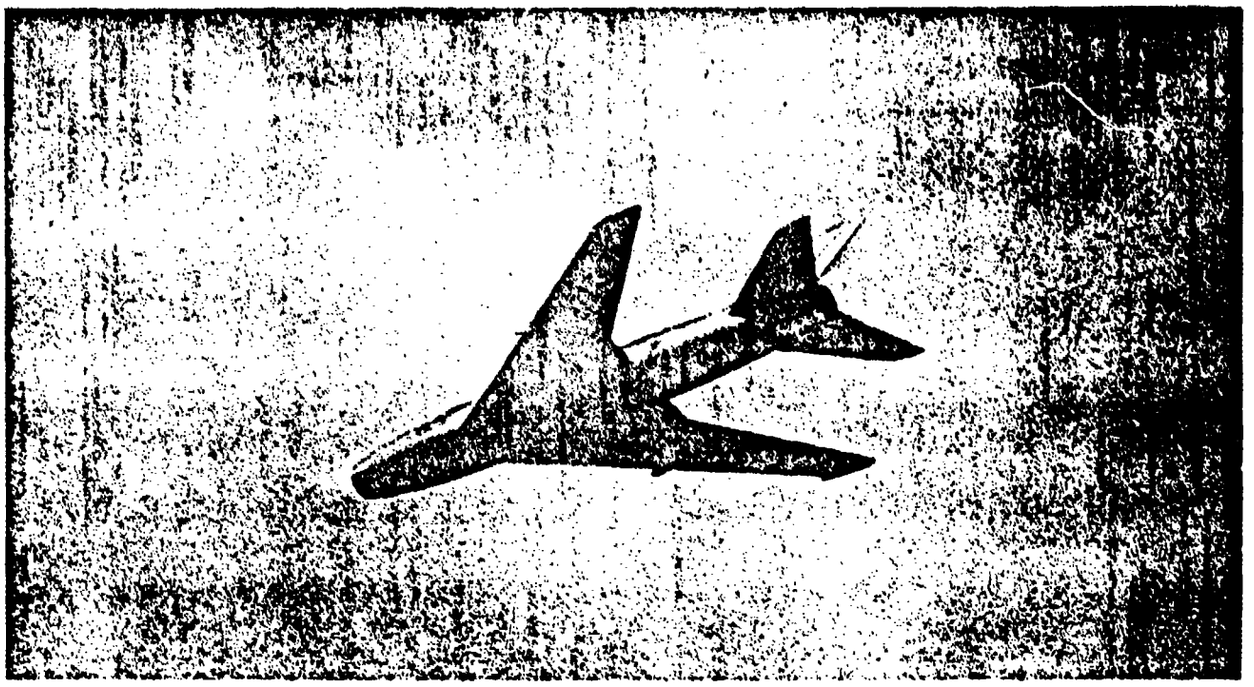
b. Engine (one turbojet engine) located inside body with air intake in leading edge of nose section and exhaust in trailing edge of rear section.

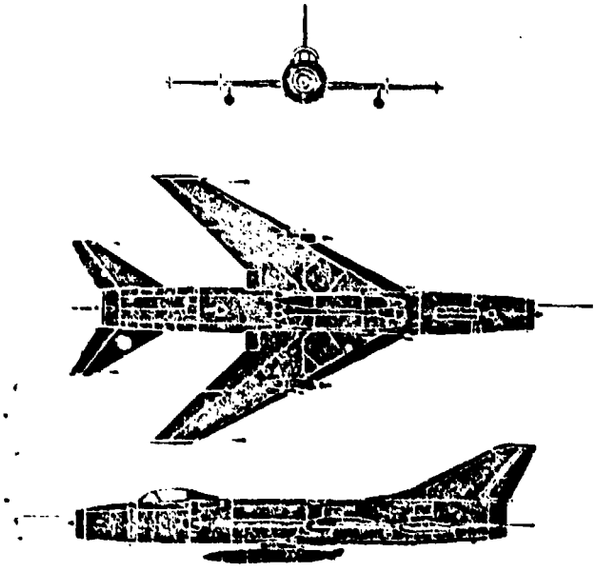
c. Long, tubular body with blunt nose and rear section and bubble cockpit set well back on nose section.

d. Sharply backswept, tapered tail fin and flats with square tips; small belly fin below tail.

User nations: Afghanistan, Albania, Algeria, Bulgaria, Cuba, Czechoslovakia, Egypt, Finland, German Democratic Republic, Hungary, India, Indonesia, Iran, Iraq, North Korea, North Vietnam, People's Republic of China, Poland, Rumania, Sudan, Syria, USSR, Yugoslavia.

FIGURE B. The MIG-21 FISHBED





The Su-7 FITTER is a single-seat, jet, ground attack fighter manufactured in the USSR for service with the Soviet Air Force. Versions of this aircraft have been exported to certain East European and Middle East nations.

Dimensions and Performance:

Wingspan	30 feet (9 meters)
Length	50 feet (15 meters)
Maximum speed	1,055+ mph (917 knots)
Maximum range	780 nautical miles
Service ceiling	49,700+ feet

Recognition Features:

a. Low-mounted, semidelta, backswept wings with tapered edges and curved wingtips and wide roots.

b. Engine (one turbojet engine) located inside the body with round air intake in forward end of nose section and round exhaust in trailing end of rear section.

c. Long, tubular body with blunt nose and rear section. Bubble cockpit located atop the nose section forward of the wing roots.

d. Tapered, backswept tail flats and fin with curved tips.

User nations: Afghanistan, Czechoslovakia, Egypt, German Democratic Republic, India, Iraq, North Korea, Poland, Syria, USSR.

Figure B-1. Su-7 FITTER

hand, require steeper attack angles and higher altitudes to initiate the attack. While bombing and rocket attacks against helicopters are not likely, they should not be completely ruled out.

The overall probability of any attack by high speed aircraft is relatively low, but if helicopters are employed in large formations the potential increases significantly. In addition, Soviet fighter aircraft must maneuver to initiate this type of attack. It is true that strafing can be done at low angles of attack but this still requires a deviation from the original flight path and a realignment of the aircraft on the target. If this restriction can be overcome with the development of a look-down/shoot-down capability then the probabilities will certainly increase drastically.

U.S. fighter aircraft have this look-down/shoot down capability. It allows greater flexibility when attacking targets, increases the element of surprise and decreases the chances for a counterattack on the fighter. In all, a very effective departure from gunnery techniques of the past and a potentially hazardous situation for heliborne operations in the future.

Air-to-air helicopter weapon systems designed for the mid-1980's must have the capability to deal with the high performance aircraft threat. The altitudes, ranges

and speeds at which these aircraft operate make a simple cannon system ineffective as a defensive tool. With this in mind, careful consideration must be given to the proper selection of weapons, whether they are mutually supporting one another or designed for multirole employment against a broad envelope of aircraft.

Now a look at the potential helicopter threat.

> The presence of armed enemy helicopters on the battlefield presents a unique and perhaps a far more serious threat than the fighter. This is because weather often precludes the use of high performance fighters; but if the weather permits us to employ our helicopters, the enemy can employ his. Moreover, they operate in our envelope and have range effective weapons similar to our own.[4]

In the USSR the development of an attack helicopter came considerably later than most western armed forces. Soviet helicopters of various types and with a variety of weapons only began to appear in 1967. Since that period the Soviets have examined and improvised many helicopter/weapons systems, but it was not until 1973 that an aircraft designed specifically as a combat helicopter appeared. The appearance of the MI-24 (HIND) (Figure C) combat helicopter signaled to the west, that although the USSR started their development late, their product may be greatly superior to ours. (Specifications: Figure D.)

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[4] Ibid., p. 2-16.

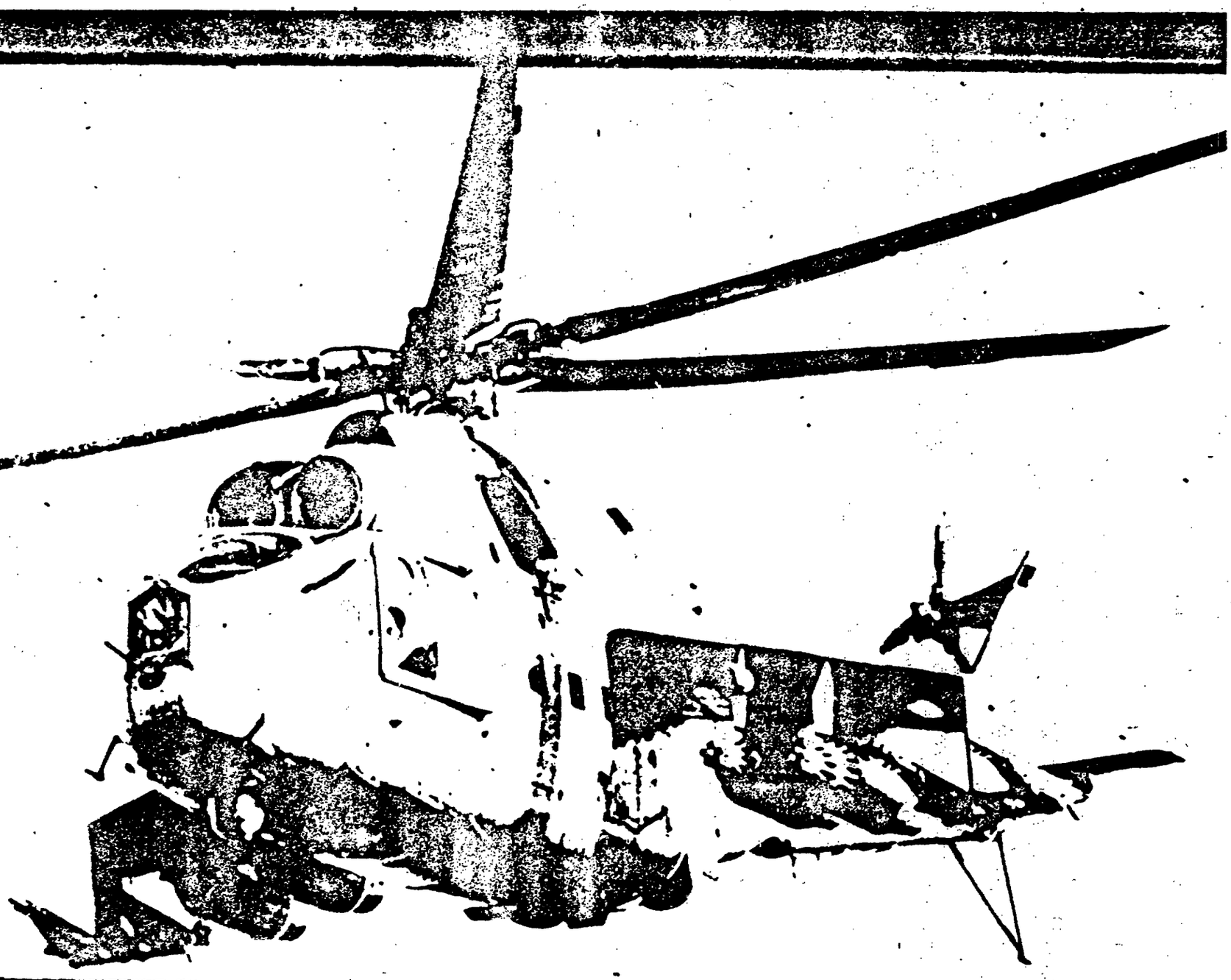
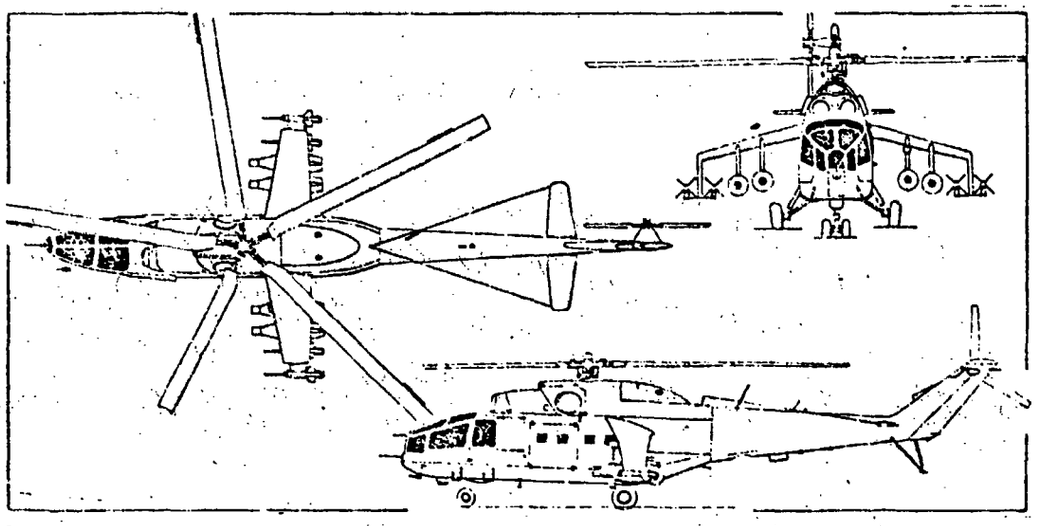
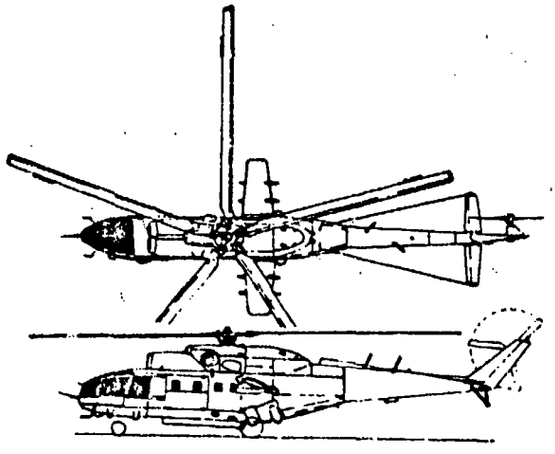
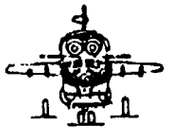


Figure C. The MI-24 HIND



◄ Three view drawing showing the combat helicopter design of the *Hind A*. This is above all achieved by the relatively slender fuselage and the two lateral stub wings, which serve as carriers for the six external weapons stations.





The Mi-24 HIND A is an antitank helicopter (gunship) manufactured in the USSR. There are two versions of the Mi-24; HIND A and HIND B. Both versions have short weapons carrying wings mounted about midfuselage.

Dimensions and Performance:

Rotor span	71 feet (22 meters)
Wingspan	23 feet (7 meters) (approx)
Length	65 feet (20 meters)
Maximum speed	160 mph (140 knots)
Maximum range	260 nautical miles (estimated)
Service ceiling	Unavailable

Recognition Features:

a. Large five-blade rotor mounted on top of body midsection.

b. Engine pods (two turboshaft engines) mounted at top of body midsection with large air intakes above cockpit and exhaust ports centered above each side of body midsection.

c. Large glassed in cockpit and tapered rear section. HIND A has wings with a pronounced negative dihedral and three weapons stations, retractable launching gear.

d. Swept backward tapered tail flat. Tapered, backswept tail fin has small rotor mounted on conical extension on right side.

User nation: USSR.

Figure D. MI-24 HIND

The following extract from the Handbook on Soviet Ground Forces reflects the fire support requirements placed on helicopter weapons:

> a. The Soviets are increasing the firepower of helicopters, with the aforementioned Hind-A being the most significant development. In addition to cannon and machineguns. Soviet helicopters are being armed with guided and unguided missiles.
>
> b. Soviet publications have noted the effectiveness of heavily armed helicopters becuase of their ability to operate at low altitudes, and to remain in zones of AA (anti-aircraft) fire for short periods of time needed to guide an anti-tank missile.
>
> c. The Soviets also stress the need for defensive measures against Western helicopters in combat situations, noting the need to be alert and react rapidly when defending against attacking helicopters.[5]

The Soviet HIND combat helicopter is designed to accomplish all of the previous tasks, plus carry combat troops. It is armed with a heavy, 12.7 mm machinegun which provides self-protection, radio-command guided anti-tank missiles and wire-guided anti-tank missiles for offensive employment. In addition, the HIND can carry 57 mm unguided hollow charge rockets, air-to-surface missiles (160, 210, and 240 mm), gun pods with 23 mm twin cannons and finally bombs up to 250 Kg.

The MI-24 HIND is designed for a crew of three. The side-by-side seating arrangement of the pilots accounts for the width on the aircraft. The gunner, who has the weapons sighting systems, is located in the nose section in

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[5]U.S. Army Field Manual 30-40, Handbook on Soviet Ground Forces, 30 June 1975, pp. 6-95.

front and below the pilot and copilot. He controls the air-to-surface weapons and the machinegun mounted in the nose. Beyond the crew of three, the aircraft can accommodate up to 16 lightly armed troops or an infantry anti-tank squad consisting of eight soldiers and a group commander with anti-tank weapons.

The HIND is carefully built for survivability, it has armor protection on the foremost frame to protect against frontal hits. The fuel cells also have some armor protection, particularly the main cell in the rear compartment. In addition to this, the front canopy is made of bullet-proof perspex and the aircraft is equipped with a fire warning system with a very effective fire extinguishing system. The MI-24 HIND is one of the most versatile combat helicopters in the world, and probably the most capable of survival on a European battlefield.

The unique employment of this combat helicopter is a complete departure from the normal Soviet helicopter tactics used in the past. Previously, the helicopter was looked upon by the Soviets as a support vehicle, capable of only lifting troops and supplies. Rarely was it thought of as a combat vehicle, mainly because of its slow speeds, limited weapon systems and overall extreme vulnerabilities. The HIND was designed to correct these deficiencies and as a result operational concepts were carefully thought out. With this aircraft the Soviets are capable of inserting

elite forces or anti-tank elements into the rear areas of any opposing force. And the significant advantage of this aircraft is its capability to carry the troops and neutralize opposing force positions with a wide variety of onboard weapons, a very effective combined arms team. This form of operation would insure the seizure of vital areas in advance of their rapid ground thrusts. Another innovative approach is the use of combat helicopters to insert or withdraw small reconnaissance and sabotage patrols. This is a critical operation to disrupt and disorganize the enemy in support of major offensive operations.

> Similar tactics, with separate helicopters for personnel transport and weapons missions, have already been successfully tested in the United Kingdom and in France. Such tests seem to confirm Soviet tactics in this field.[6]

Heliborne assaults are also frequently used to seize key objectives as much as 50 kilometers ahead of a main attack effort. The Soviet front would have sufficient helicopters for a one-time lift of a motorized-rifle battalion, less personnel carriers. Such lifts would be augmented by combat helicopters to insure the assault force has adequate protection. This type of operation can also be used quite effectively to fix and prevent movement of enemy reserve forces. Because of shock and surprise, Soviet helicopter assaults are currently used in conjunction with parachute operations against enemy nuclear delivery

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[6]Alexander Malzeyev, "The Soviet MI-24 (HIND) Combat Helicopter," International Defense Review, June 1975, p. 121.

units, logistic support units, communications centers and enemy rear area installations. The MI-24 HIND will be utilized to its maximum capability to support all of these operations and provides the Soviet forces a very effective close air support weapon.

In summary, the possibility of aerial engagements between attack helicopters is very high, particularly in view of the increased utilization of the HIND in many different roles and operations, and as we will see, the Western armies extensive use of helicopters on the battlefield. To counter these weapons, careful consideration must be given to their design, survivability and employment. All of which will place various limitations on the selection of an effective air-to-air system.

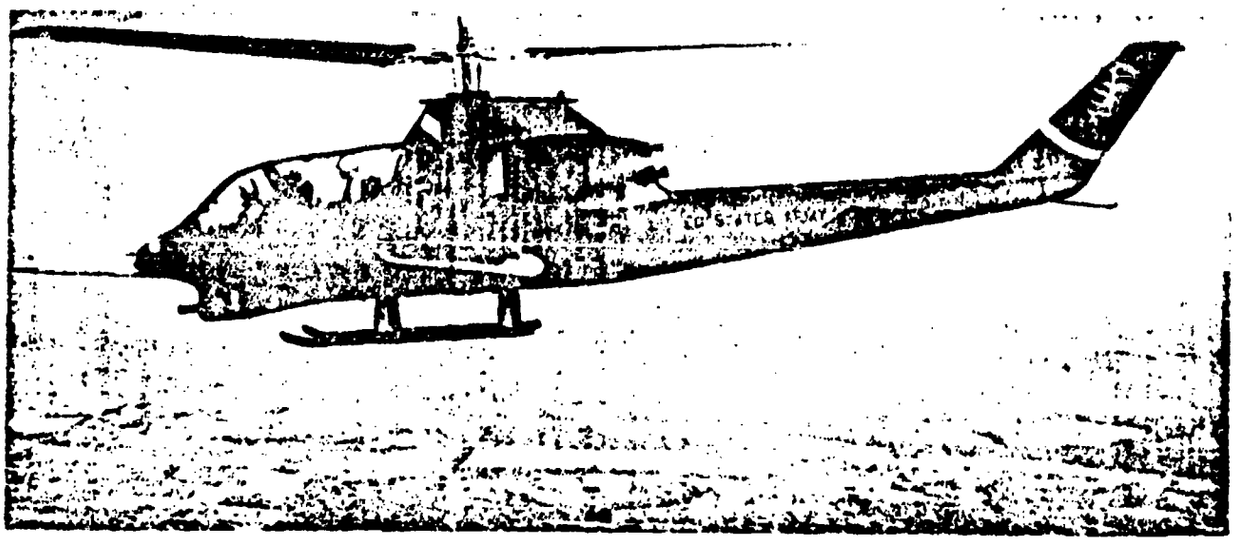
To understand U.S. Helicopter requirements in tactical operations we need first to comprehend current employment techniques for the European battlefield, and second, to look ahead to future methods of employment. This is the subject of our next chapter.

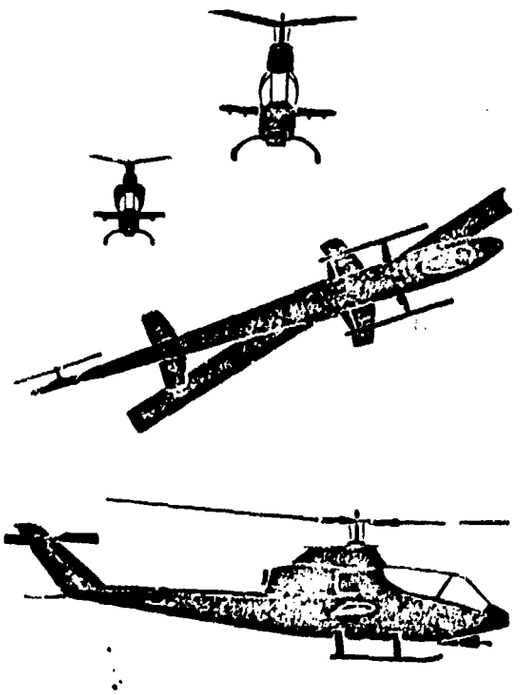
CHAPTER III

HELICOPTER OPERATIONS

This chapter examines the current U.S. Army Helicopter Employment Doctrine and its significant relation to the overall vulnerabilities and limitations of rotary wing aircraft. This constitutes the basis for developing the weapons systems that counter those threats existing under employment techniques and current operational doctrine. Second, future employment doctrine must consider those areas that will occur as an outgrowth of new helicopters and anti-helicopters weapons systems produced and integrated into U.S. and Soviet military arsenals. Understanding the new roles and proposed employment techniques of such systems is vital to determining vulnerabilities, limitations and weapon configurations of the future. In considering what weapon systems will be needed in the mid-1980's to counter the air threat against helicopters, it is extremely important to first determine the degree of emphasis placed on their use on the battlefield. This chapter describes the U.S. Army's anticipated use of helicopters in tactical operations.

Recently, ten attack helicopter units were deployed or reorganized with the AH-1Q/S Cobra (Figure E) attack





The AH-1 Cobra is a heavily-armed attack helicopter manufactured in the United States. Fitted with armored protection for its two-man crew, it is designed for low-altitude, high-speed search and target acquisition, reconnaissance by fire, multiple-weapon fire support, and troop-helicopter escort. The US Army and Spain use the single-engined AH-1G. The US Marines use the twin-engined AH-1J of which an even higher-powered version is used by Iran.

Dimensions and Performance:

Rotor span	44 feet (13 meters)
Wingspan	10 feet (3 meters)
Length	54 feet (17 meters)
Maximum speed	219 mph (190 knots)
Maximum range	310 nautical miles
Service ceiling	11,400 feet

Recognition Features:

a. Short, stubby, midmounted wings with square tips. Large dual-blade rotor mounted above hump on top of body midsection.

b. Engine (one or two turboshaft engines), mounted on top of body midsection, forms a hump-like appearance with exhaust or port(s) above rear body section.

c. Thin, oval body with pointed nose, stepped-up cockpit, and tapered rear section forming tubular tail boom.

d. Backward-tapered, blunt-tipped tail flats midmounted on boom well forward of backswept, slightly backward-tapered tail fin. Small rotor mounted on left side of tail fin.

User nations: Iran, Spain, USA.

Figure E. AH-1 Cobra

helicopter and assigned to the U.S. Seventh Army in Europe.

> The present force of 230 AH-1 will be the Army's airborne anti-armor force in Europe until 1983, when the first of two new attack helicopter battalions will arrive to boost the total force to 370 anti-armor helicopters. Some of these may be AH-64 Advanced Armed Helicopters, although present planning is based on additional AH-1S.
>
> The AH-1S are being counted on to provide a force to first slow and hinder the initial surge of any massive Warsaw Pact armored thrust and a heavily armed tank-killing capacity that can be quickly massed at pivotal points on any future battlefield.
>
> Experience in recent North Atlantic Treaty Organization maneuvers indicates that with proper employment and low-level flying to provide concealment from visual observation, the AH-1 can strike from a standoff range of nearly 5 km (3.1 mi.) and achieve tank kill ratios greater than 15:1.
>
> This would make the Army's present Cobra force in Europe the equal of nearly 3,500 tanks.[1]

All four U.S. divisions in Germany now have an air combat battalion. Each battalion has two attack helicopter companies, equipped with 21 Cobra's and 12 OH-58 Scout Aircraft. (Organization: Figure F.)

The primary mission of the OH-58 in the Aero Scout Platoon is to see the battlefield, acquire targets and coordinate movement of the attack helicopters. The Aero Scouts coordinate the entire mission with the ground commander and the attack platoon leader. This will maximize the assets available and avoids duplication of targets with

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[1]David A. Brown, "Cobra Bolsters U.S. Stance in Europe," Aviation Week and Space Technology, Vol. 107, No. 20 (14 November 1977), p. 40.

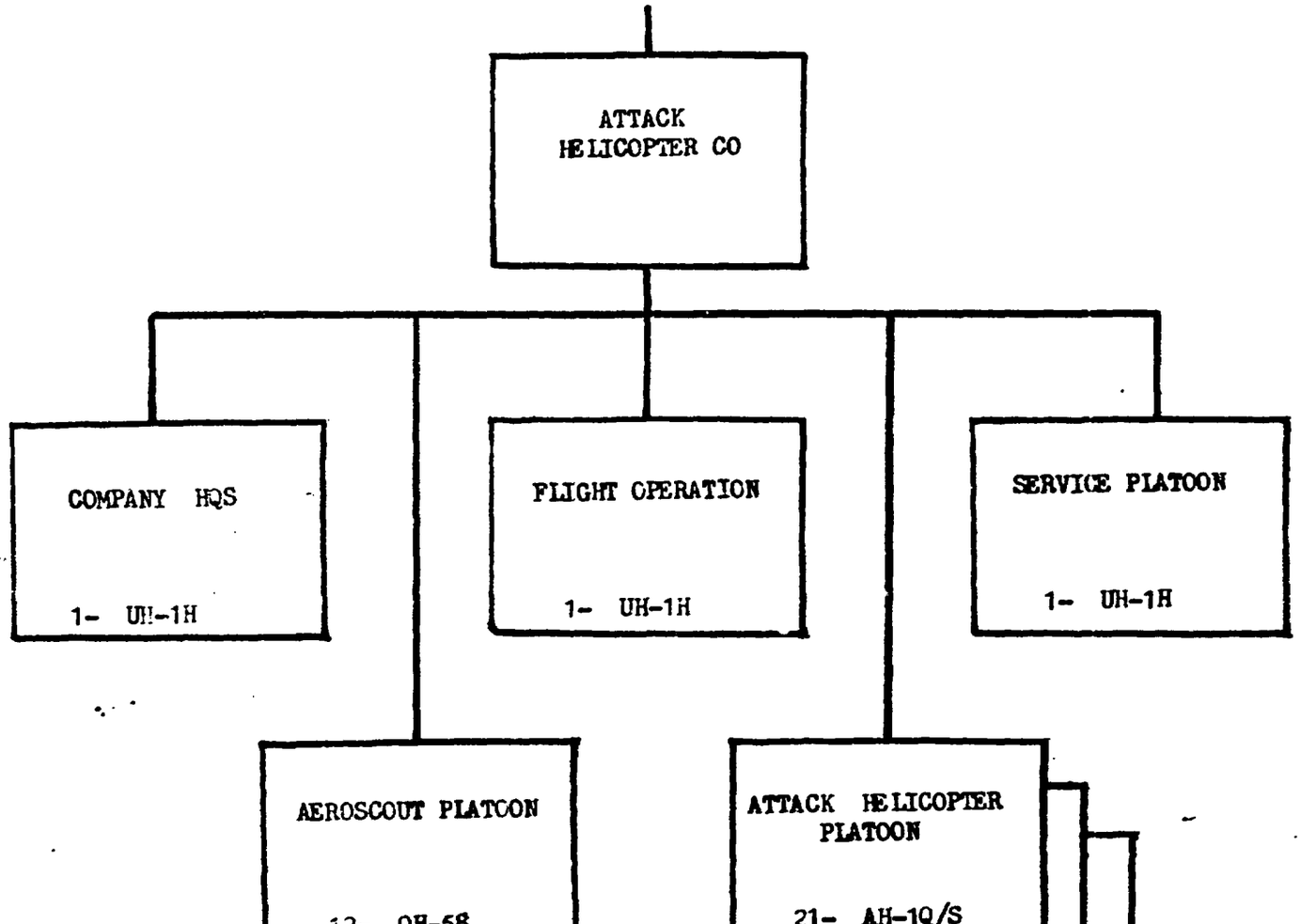

Figure F. Type Attack Helicopter Company (US Army)

other critical anti-tank weapons. The Aero Scouts will select the best Cobra attack positions that provide the most efficient concealment and standoff range to the target. And finally, the OH-58 provides local security to the attack helicopter while they engage the target. This security mission consists only of early warning, adjusting of artillery fire and directing tactical air missions. The Scout normally is equipped with one side mounted machinegun, which provides very little area fire capability and no flexibility for air-to-air engagements.

Of course the real combat power of an attack helicopter unit is in its attack helicopter platoons. These attack helicopter platoons are habitually employed against armor and mechanized targets. But other hard targets such as bunkers, storage facilities and fixed installations may be engaged effectively, if the situation arises. The attack teams are very careful not to remain in one attack position during the entire mission. Their advantage of mobility and nap-of-earth flying techniques allows them to shift the direction of attack and engage the enemy's flanks from multiple positions. Both employment techniques provide a margin of survivability, not only for the aircraft and crew, but also for their anti-armor combat power.

The survivability of these attack teams depends on their ability to visually recognize a threat, either air

or ground, and either take evasive actions or if committed attempt to use the weapons they have available. Defensive weapons available must realistically be defined as those weapons organic to the team. This is because of the response time to defend the team is very low and will not allow the team to call for assistance in most cases. The weapons available to the AH-1S is the 7.62 millimeter high rate automatic gun, the 40 millimeter grenade launcher, the 20 millimeter gun or 2.75 rocket launchers all of which will limit the anti-armor armament. In most cases, the tailoring of weapons on the Cobra will be specifically anti-armor capable, and this leaves very little options for the other weapons. These other weapons can provide some area protection, that is air-to-surface, if they are available at the time of engagement. As for an air-to-air engagement, defensive evasive maneuvers are probably the best solution at present. The proposed doctrine concerning air-to-air engagements is outlined in training circular 1-7 (Draft), Helicopter Aerial Defensive Tactics.

> Marginal weather conditions will reduce or even eliminate the threat of high performance fighter aircraft. However, that does not mean you are 'Home Free'. Many countries of the world realize--as we do--the advantages of armed helicopters in various combat roles, and are developing these aircraft in large numbers. It is logical to assume that if weather conditions allow us to operate our rotary-wing aircraft, the enemy is likely to be operating his.
>
> If your unarmed helicopter is acquired by an armed helicopter, the principles for evading fighter aircraft

aircraft do not necessarily apply. This is because he is operating in your speed and maneuverability envelope. Additionally, the off-axis weapons systems mounted on most armed helicopters do not allow you to complicate his gunnery problems to any appreciable degree by maneuvers. Unlike the fighter, if the enemy helicopter can see you, he can hit you. This is especially true of the sophisticated, heavily armed, MI-24 HIND. The surest means of survival against enemy armed helicopters is to see him first. If you are able to do this, you may be able to hide and avoid detection; then report his activity to someone capable of taking action against him.

If you are acquired by an armed enemy helicopter, evasive action must be initiated at once. You are clearly in jeopardy at this point because the flexibility of his weapons and the similarity of flight envelope permit him to attack instantly if you are in range. First, find cover and concealment behind trees or terrain. If the ceiling is extremely low, you may seek the protection of the clouds. This may be too risky, however, if radar-directed air defense weapons are a significant threat in your area. Attempt to fly to the vicinity of friendly air defense and seek assistance.

If you are flying an attack helicopter and come up against the MI-24 attack helicopter, your best defense is to mask immediately. If you are certain he has acquired you, it's a good idea to fire a pair of rockets and/or a burst of minigun fire while masking. Your chances of a hit are perhaps negligible, and the chances of a kill even less; but he may just believe you have fired air-to-air missiles at him. If so, he may be more concerned about getting away than attacking. Remember, unless you are armed with air-to-air capability, he has you out gunned.

Basically, then, if you encounter enemy armed helicopters, attempt the following:

-Seek immediate concealment
-Get out of range of his weapons
-Get help from friendly air and ground elements.[2]

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[2]U.S. Army Aviation Center, Training Circular 1-7, Helicopter Aerial Defensive Tactics, July 1977 (Draft), pp. 49-50.

From this we see there exists a greater need for detective equipment and defensive weapons, active and passive, to insure these attack teams can accomplish their mission and the mission of their company.

The attack helicopter company has the mission to destroy or disrupt enemy armor and mechanized forces by aerial firepower. This mission is very effective on battlefields characterized by large moving enemy forces because of the helicopter's mobility advantage over armored vehicles. A European battlefield is visualized as containing massed Soviet forces and, although these forces will be large, exposed or assailable flanks will exist, allowing attack helicopters units access to those flanks to cause destruction, disruptions, and confusion. These attack helicopter units are at present organic to air cavalry combat brigades, aviation groups, air assault division and now to nearly all U.S. divisions.

The attack helicopter unit, as described in FM 90-1, Employment of Army Aviation Units in a High Threat Environment, is oriented on the attack, combined with relentless pressure on enemy forces. This relation to the attack is very useful in the Movement to Contact of friendly forces, where they are employed as part of the advance forces to gain contact and develop the desired situations necessary for the success of the ground forces. This is achieved by the mobility of the attack helicopter, capable of providing

the maneuver force commander with the maximum of early warning to an enemy concentration or tactical operation.

In addition to Movement to Contact, attack helicopter units are effective in the Deliberate Attack and Reconnaissance in Force, both of which concentrate on destruction of the enemy to reach significant objectives. Once the previous operations are successful, attack helicopters are ideally suited for Exploitation and Pursuit of relinguishing enemy forces. In the Exploitation, friendly forces will advance on multiple routes, including aerial routes. More importantly, movement must be rapid to secure deep objectives and pressure must be continued without breaking contact. Such a role is an extremely effective mission for the attack helicopter. On the other hand, attack helicopters employed during pursuit operation may inflict maximum destruction on the retreating enemy and will permit freedom of action to friendly forces. Obviously, the use of anti-armor attack helicopters in standard maneuvers have provided a high degree of versatility to the ground commander and has placed them equally as high on the Soviet commander's threat list.

The incorporation of attack helicopters with the standard maneuver unit is just one area it can excel. Another is with the air cavalry troop (Organization: Figure G). The air cavalry troop is organized to perform reconnaissance, security and economy of force missions.

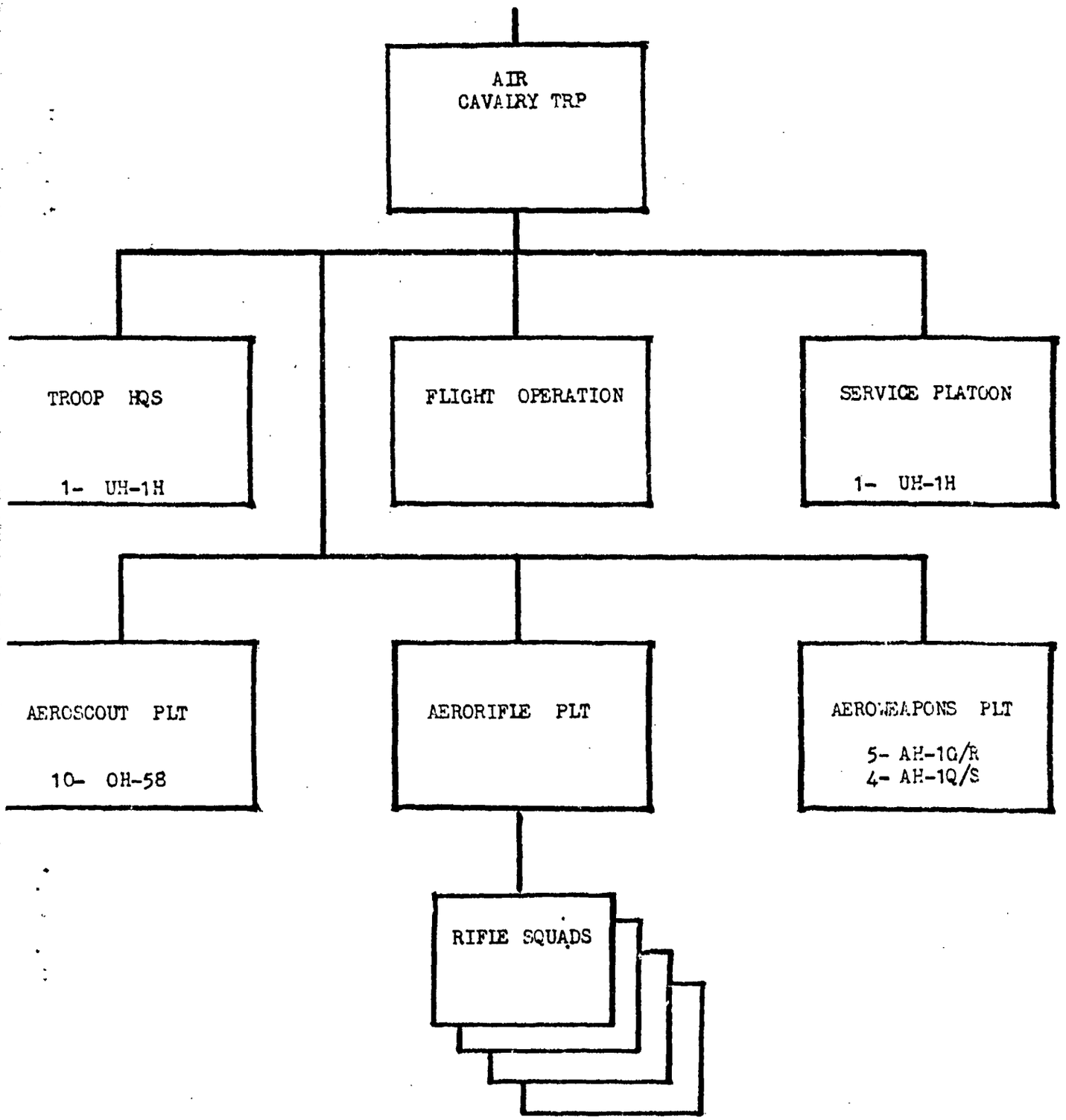

Figure G. Type Air Cavalry Troop (US Army)

First, the reconnaissance mission orients its operation on intelligence gathering and intelligence objectives. The collection of information is the primary task and must not be jeopardized by unnecessary combat action. Under this circumstance, the attack helicopter's provides escort and coverage for the intelligence element and are prepared to support and disengage this element to preserve the mission and the unit's integrity.

The security mission differs in that it provides a projected force adequate and timely warning of enemy approach. The fire support for the remainder of the troop, i.e., the aeroscouts and aerorifle platoons, is provided by the attack helicopters in the aeroweapons platoon. This platoon may be used to harass, suppress, and disrupt enemy forces or to deceive them as to the location of the security force. And finally, the economy of force role is a skillful and prudent use of combat power to accomplish the mission with a minimum resource expenditure. In simple terms, the air cavalry can be utilized in a particular area to allow the commander to maneuver the maximum number of his other forces to another area to engage in decisive combat. The employment of the air cavalry troop, as suggested in FM 17-47, Air Cavalry Combat Brigade and FM 90-1, Employment of Army Aviation Units in a High Threat Environment, provides the ground commander with an increased capability to engage in combat operations over a wide area or front.

The final role in attack helicopter employment is in support of air assault or airmobile operations.

> The mobility and tactical flexibility inherent in the air assault division are capable of being exploited and employed with decisive effect against conventional or unconventional enemy forces in either a low or mid-intensity environment. The air assault division has been characterized as the army's 'All Purpose' division. This is suggestive of the broad spectrum of tactical purposes and environments for which the division is capable of being employed.[3]

The aviation units (Organization: Figure H) of the air assault division include an aviation group with two assault helicopter battalions, one assault support helicopter battalion, and an attack helicopter battalion. The attack helicopter battalion consists of 63 AH-1S (Cobra) attack helicopters that are capable of mounting up to 8 anti-tank missiles each. The final aviation element consists of an air cavalry squadron consisting of three air cavalry troops and one ground troop. This squadron (Organization: Figure I) consists of 27 AH-1 (Cobra) in various weapon configurations for a variety of missions to support the air assault operations.

Air assault operations are described in PT 3-3, Fundamentals of the Air Assault Division, are those in which combat forces are maneuvered on the battlefield by Army aircraft under the ground commander's control. They are

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[3]U.S. Army Command and General Staff College, Program Text 3-3, Fundamentals of the Air Assault Division, August 1977, p. 2.

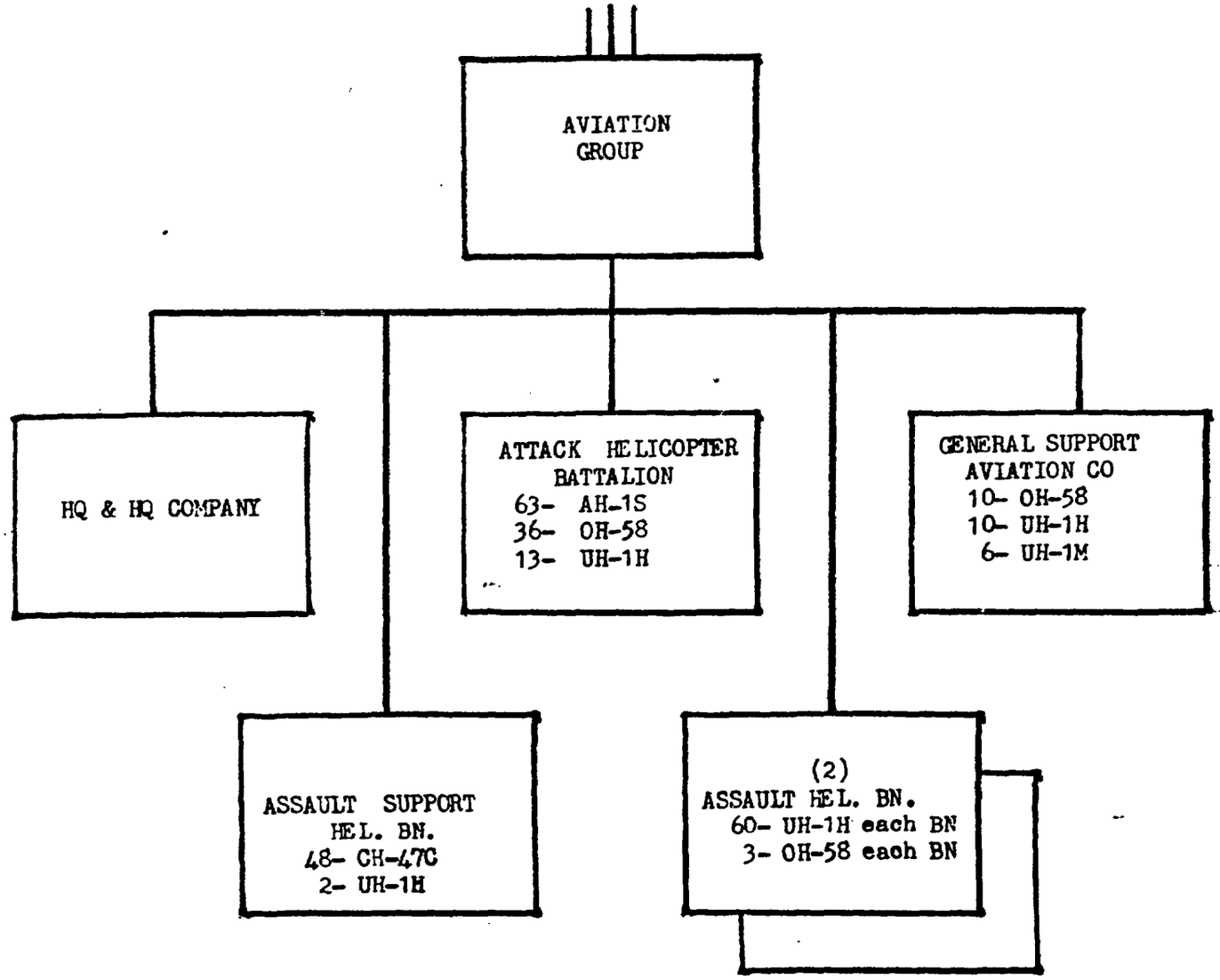

Figure H. Type Aviation Group Organization.

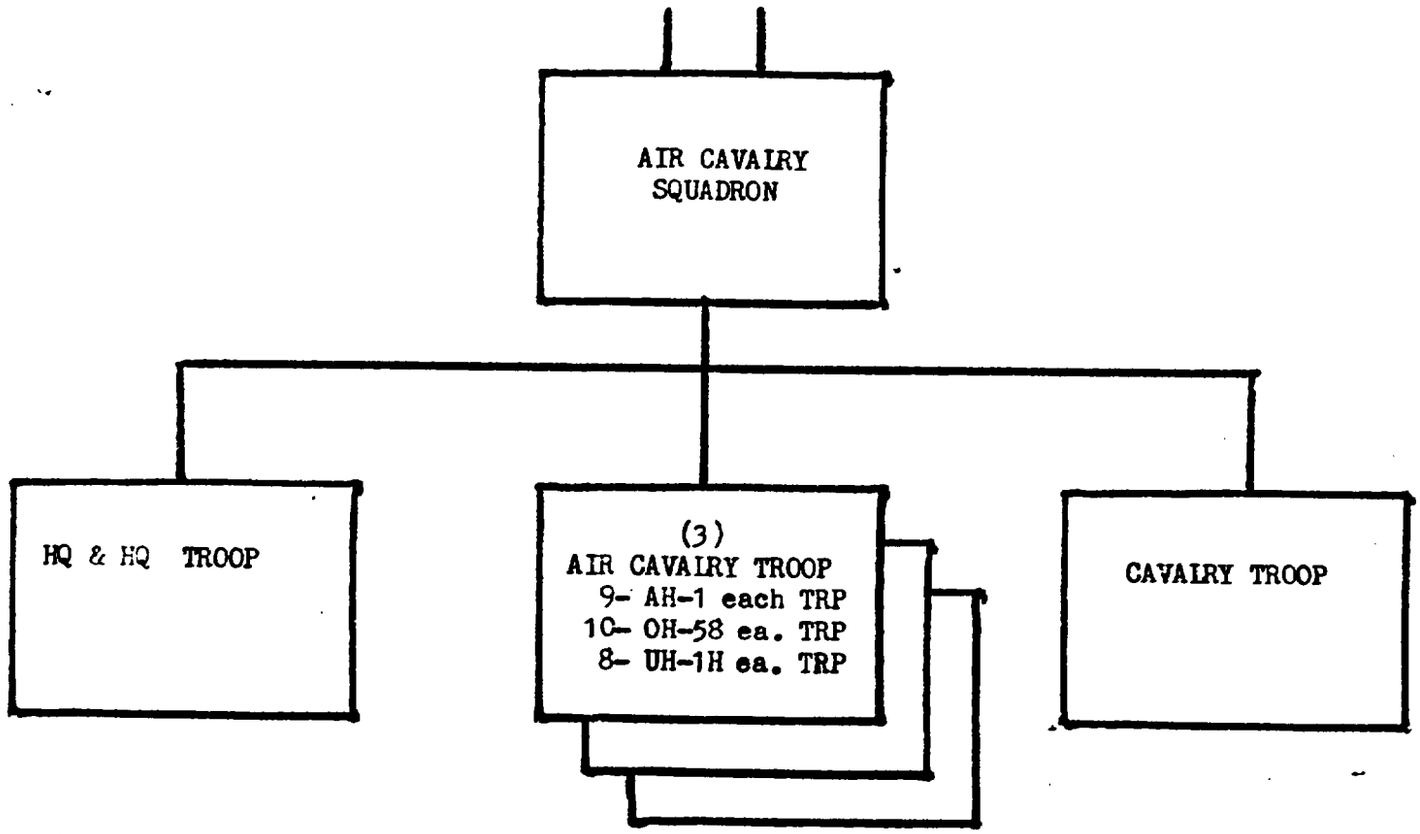

Figure I. Type Air Cavalry Squadron Organization.

used to gain surprise, flexibility, maneuver, timing and speed and are conducted over extended distances with little regard for terrain obstacles. The assault helicopter unit provides the tactical mobility for combat troops, weapons, equipment and supplies, but to accomplish the assault mission, the attack helicopters must be capable of providing direct anti-armor aerial fires and area suppressive fires, in addition to providing an escort for the actual movement. The vulnerabilities then become quite clear, particularly when considering that no air-to-air weapons are currently equipped on any U.S. helicopter. At best, the attack helicopters can only provide suppression of ground weapons during air assault operations and are subject to the limitations in the ability of Air Force and Air Defense elements to achieve local air superiority along flight routes and in the objective area.

Regardless of the air-to-air void, the attack helicopter is a highly valued weapon system in current employment doctrines, and it is particularly likely that this high regard will continue. At present new manuals are being written to expand the use of helicopters on the battlefield, and proposed employment tactics may include supporting roles in raid operations. The concept of a raid, as outlined in FM 90-1, is one of small scale attacks into hostile territories, usually across the FEBA and normally ending with a planned withdrawal or disengagement

upon completion of the mission. The specific missions involved could include the capture of prisoners, installations or significant enemy equipment or material. Other missions could seek to acquire specific information, such as critical unit dispositions, strengths, capabilities or methods of employment, all of which are vital in a nuclear environment. Raids can also be organized to destroy a variety of enemy assets and are particularly useful as a deceptive measure to mislead the enemy as to the purpose and location of friendly activities.

Other projected missions include the use of helicopters in mine-laying operations. With the development of aerial delivered mines (M-56), this concept has opened a vast number of alternatives on the battlefield. The M-56 is a member of the family of scatterable mine system (FASCAM).

> The FASCAM is a means to rapidly deliver anti-armor and anti-personnel mines. The system includes mine delivery by helicopter, artillery, high-performance aircraft, rockets, ground dispenser, and maneuver unit assets.[4]

Mines not only could be placed as barriers to advancing enemy forces, but it is conceivable that they might be aerial delivered behind retreating or withdrawing enemy forces. The delivery of mines by helicopters would allow commanders to revise tactical barrier plans and decisions,

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[4]U.S. Army Command and General Staff College, Reference Book 30-2, Selected US and Soviet Weapons, Key Equipment, and Soviet Organization, July 1977, p. 65.

then achieve maximum benefit by their rapid aerial emplacement.

Another consideration for the employment of attack helicopters may be in the suppression of anti-aircraft acquisition radars. Missiles currently under development and launched by aircraft, will be capable of tracking signals emitted by radars and of destroying their antennas. This will allow helicopters a little more freedom of movement, because these radars are capable of tracking aircraft even behind terrain masses. The visual acquisition of aircraft is difficult particularly if the aircraft are conducting nap-of-earth techniques. And, although, recent tests have proven that helicopters operating in the nap-of-earth environment can operate below anti-aircraft radars and maneuver effectively to accomplish their mission, destroying the radars capability will assist Air Force aircraft in their close air support of maneuver elements. This suppression mission would provide a void in the enemy's air defense system, particularly in their coordinated efforts.

> The coordination of the fire direction radars of several batteries is undertaken by the battalion commander. This is done to provide the best low altitude coverage. Each radar is given a specific sector. Whenever one radar detects a target, it goes into a tracking mode and sends target coordinates to the guns in other batteries.

> Considerable importance is placed on anticipating the avenues of approach that helicopters can use to attack critical assets.[5]

With the radars ineffective, the enemy air defense system will have difficulty in anticipating helicopter movement having lost the benefits of following the aircraft across the terrain, prediction capabilities will also certainly be hampered. The visual observation of helicopters is continually being tested and evaluated in all exercises.

NATO exercises by the 101st Air Assault Division on Reforger 1976 also provided considerable evidence to support the across-FENA operations with the use of raids, as well as air assaults. More recently, though, Aviation Week and Space Technology stated:

> During NATO Reforger exercises in West Germany during August and September, one Cobra unit, made repeated attacks on a 90-tank aggressor force during one day without being observed visually by anyone in the tank force, umpire reports indicate.[6]

Such training, planning and execution consistently brings the desired solution to overwhelming problems.

The increased purchases of helicopters and the development of new helicopters make it very apparent that the U.S. Army is going to continue to exploit rotary wing aircraft capabilities in the future. The newest utility

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[5]U.S. Army Aviation School, Field Manual 90-1, Employment of Army Aviation Units in a High Threat Environment, 30 September 1976, pp. 2-9.

[6]Ibid., p. 40.

helicopter, the UH-60 Blackhawk, and the advance attack helicopter AH-64 (currently under development) will find their way onto the battlefield with improved and expanded employment techniques and roles. These aircraft will also be armed with a greater variety of weapons and aircraft survivability equipment (ASE) to meet those new demands and capabilities.

In summary, the greater use of helicopters, particularly the attack helicopters on the battlefield will also increase the attentions and desires of the enemy to meet and defeat this formidable threat. The greater roles adopted by the advanced attack helicopters will have direct influence on design and weapons it ultimately will carry. And, the weapons which will be carried for the air-to-air role will lie within these parameters:

> Our actions when encountering hostile aircraft are clearly defensive and encompass the following: Detection avoidance, evasive action and engagements as a matter of self-defense.[7]

Detection avoidance and passive systems are the subjects of our next chapter.

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[7] Ibid.

CHAPTER IV

PASSIVE DEFENSIVE SYSTEMS

Since the Vietnam era many tacticians have expressed great skepticism concerning the survivability of helicopters on the European battlefield in a medium to high intensity war. The formidable threat that seems to dominate the helicopter is the Soviet Air Defense tactical network. The employment of Soviet Air Defense weapons is based on three factors. The first of which is the deployment of a complementary family of surface-to-air missiles and anti-aircraft guns. Second, the mobility of these weapons to provide the air defense umbrella necessary for any anticipated maneuvering of ground forces. And third, the command and control mechanism essential to effectively mass their air defense systems. It is clear that the following array of weapons, if left unchecked, will severely limit the use of helicopters on the conventional battlefield.

CHARACTERISTICS OF AIR DEFENSE WEAPONS

Antiaircraft Guns

Caliber	Model	Effective vertical range (meters)	Maximum rate of fire (rpm)	Fire Control
23-mm	ZU-23	2,500	2,000	Optical
23-mm	ZSU-23-4	3,000	1,200	Radar or optical
57-mm	ZSU-57-2	4,000	240	Optical
57-mm	S-60	6,000	120	Radar or optical

Surface-to-Air Guided Missiles

Missile	Name	Slant range (km)*	Level of Protection
SA-2	GUIDELINE	40	High altitude
SA-3	GOA	24	Medium-low altitude
SA-4	GANEF	70	Medium-low altitude
SA-6	GAINFUL	30	Low-low altitude
SA-7	GRAIL	3.5+	Low altitude
SA-8	GECHO	10+	Low altitude
SA-9	GASKIN	7+	Low altitude

*Exact ranges are classified[1]

The helicopter's vulnerability is described as the following:

> Friendly helicopters flying with nap-of-the-earth techniques have a better than even chance of being acquired and engaged at a range of 3 kilometers or less from the threat force, provided terrain does not mask radar or visual acquisition by threat air defense gunners. The ZSU-23-4, SA-7, and SA-9 present the primary air defense threat at this range. Aircraft flying with

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[1]US Army Field Artillery School, reference note, The Threat, Fort Sill, OK: August 1976, p. 26.

> other than nap-of-the-earth techniques, but below 350 feet, are subject to acquisition and engagement at ranges up to 5 kilometers from the threat force, primarily by the SA-6 and SA-9. For aircraft flying above 350 feet, the AD threat increases sharply. Although the Threat Forces air defense weapon systems have the capability of engaging aircraft at the above ranges, it does not necessarily mean that the aircraft will be hit. That is a function of a number of variables, such as air defense gunner proficiency and their available ammunition and friendly countermeasures.[2]

The friendly countermeasures are the only variables which the U.S. Forces can hope and expect to control. These countermeasures are provided in several forms, the most important of which are those that are controlled by the helicopter crews and initiated when they are absolutely required. The exact time to utilize such a system is the most critical consideration of the entire event. To assist in this determination, warning receivers are being developed as part of the Aircraft Survivability Equipment, which are vitally necessary in assisting the helicopter to remain in battle.

Aircraft Survivability Equipment (ASE) is defined as those systems which allow an aircraft to succeed in its combat roles and missions. These systems detect the existing threats and attempt to degrade their destructive potential before they become irreversible. Such equipment is representative of a Passive Defensive System, a system which endures or is affected by the threat, but does not actively engage the enemy for purposes of destruction. Aircraft

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[2]Ibid.

Survivability Equipment includes infrared (IR) suppression kits, radar warning receivers, missile launch/approach detectors, radar jammers, infrared jammers, chaff and flare dispensers, and smoke and chaff rockets.

The current approach to ASE is based on the multi-defeat concept, that is no single system of ASE provides total protection or survivability. All systems, radar warning receivers, IR jammers, chaff, etc., must enhance and mutually support one another in order to defeat a wide variety of threat weapons. Additionally, this survivability should not be pursued to the extent that the increases in weight, size and cost either exceed the advantages of reduced attrition or degrade the primary mission of the helicopter. For this reason a great deal of attention and research is being directed toward the very basic requirements which bring the highest benefits.

Currently, most Soviet Air Defense missiles are heat seekers and track the infrared emissions from the aircraft, by reducing and dispersing the IR signatures of the aircraft the ability of a missile to seek that aircraft is reduced. Basically, there are three types of aircraft infrared signatures. First, the aircraft engine produces an IR from the hot metals of the engine itself. Second, IR sources are produced from the hot exhaust gases or plume signature as they exit the aircraft and diffuse into the air. And last, the aircraft airframe absorb and reflect IR sources

which are from internal, as well as, external origins. Reduction in any of these signatures requires an attempt to cool, absorb or lower the IR source within the aircraft, then rapidly disperse the remaining escaping infrared. This is accomplished through the use of special designed exhaust stacks or suppressors and special low infrared reflective paint for the aircraft fuselage.

The following are the currently designed suppressors:

Numerous types of suppressors are available for fixed wing or rotary wing aircraft:

OH-58	Fin Stack
AH-1S	Plug Type and Bell Scoop (Figure J)
UH-1H	Bell Scoop
UH-60A	Bent Tube

Use of suppressors, however, involves certain penalities in aircraft performance. Primary penalty is weight of suppressor itself. Improved low-penalty suppressors are currently under development.

Current suppressors when coupled with aircraft IR paint defeat Soviet SA-7 (GRAIL) and SA-9 (GASKIN) missile systems. Although airframe IR signature is not as strong as hot metal or plume signature, current technology does not allow for total airframe IR suppression. A sophisticated missile, like the US Stinger, can home on airframe signature. Soviets have not yet moved toward this type of cool detector missile. If Soviets should move toward cool detector missile systems, suppressors and IR paint would help reduce the effective range of the new missile and aid ALQ-144 IR jammer in achieving sufficient ratio to defeat missile.[3]

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[3]US Army Aircraft Development Test Activity, "Discussion--ASE," Summary paper ATZO-D-MA, Fort Rucker, AL: [24 February 1978].

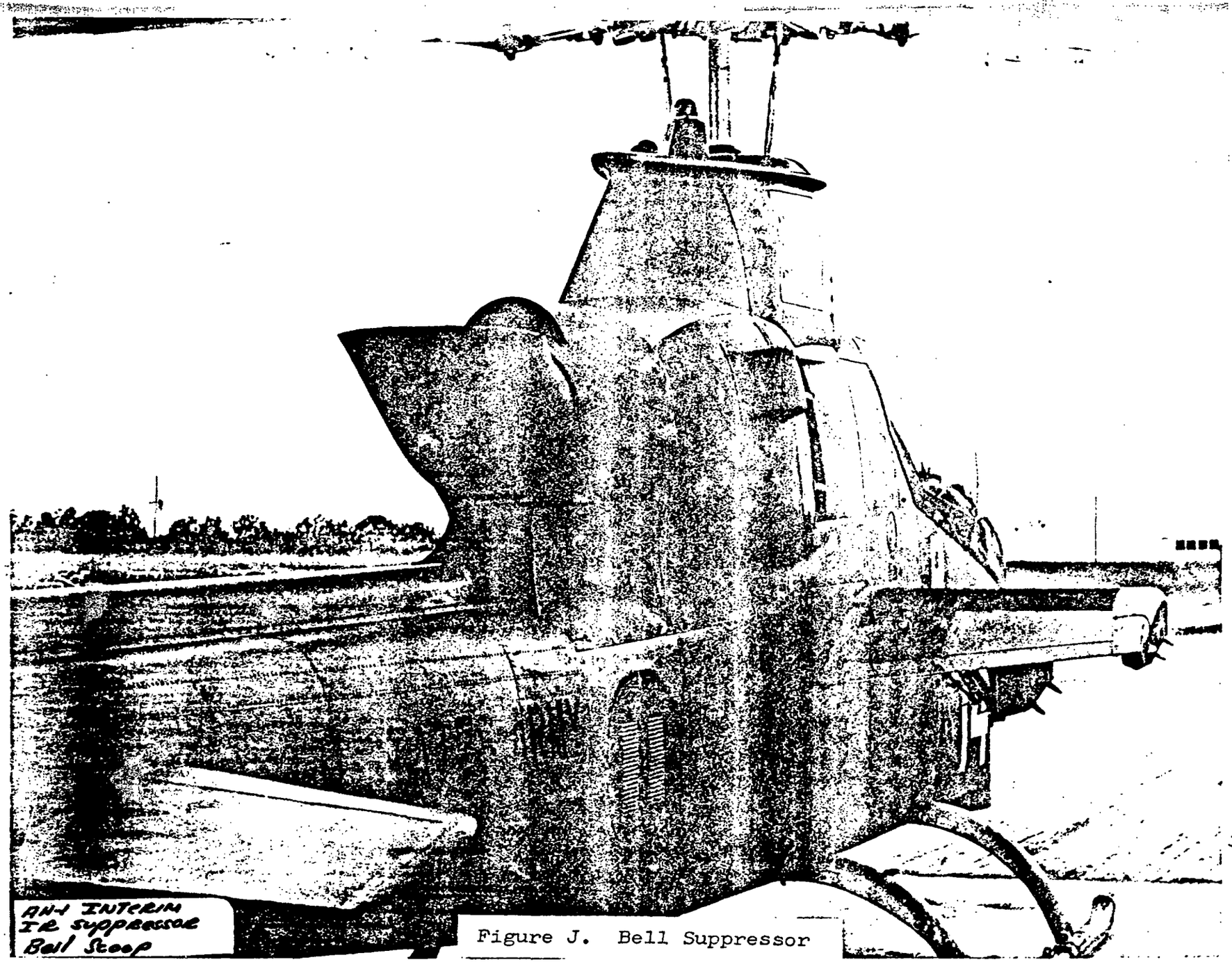

Figure J. Bell Suppressor

One other consideration in degrading a heat seeking and infrared tracking missile is to provide a significant heat or IR source which will divert the missile away from the aircraft. Such a capacity may be found in the XM-130 Flare and Chaff Dispenser system. The use of a flare, with an extremely high candle power, can provide a very effective decoy for the aircraft. But, when to use such a flare may not be as easily resolved. The XM-130 is intended for use on missions where the aircraft is exposed and is under attack. Use of this system would not further expose the aircraft, however, the initial exposure may not be completely recognized by the aircraft crew. To provide that recognition, U.S. fighter aircraft are equipped with Missile Launch/ Approach Detectors which notify the crew to a missile launch. At this point, evasive maneuvers could be initiated and flares could be dispensed. To date, consideration for the use of ML/AD's on helicopters have been rejected because of the size and weight of the system and the fact that the nap-of-earth environment effectively reduces the risks of missile acquisition and intercept. And as pointed out earlier, suppressors and IR paint on helicopters defeat the Soviet SA-7 and SA-9 missile systems, the two primary threat missiles against helicopters. The cost/benefit of a helicopter missile launch/approach detector is very low under current U.S. helicopter employment techniques.

The target acquisition of the Soviet Air Defense guns consist of both optical and radar tracking. The optical mode has been mentioned in earlier chapters and the NOE flight technique provides the best possible countermeasure. Camouflage paint on the aircraft can help with the following results:

> Test indicate when helicopter is $2\frac{1}{2}$ or more kilometers away, it is difficult to locate visually. When helicopter is within 1K, its rotor blades give it away. Camouflage paint, therefore, will only be of benefit when aircraft is between 1 and $2\frac{1}{2}$K from threat.[4]

When appraising the most viable anti-aircraft threat for a helicopter in the NOE environment, the number one consideration has to be the radar tracking anti-aircraft gun. This weapon is found in great numbers at the Soviet organizational level where the attack helicopter will normally be operating. To counter this threat several systems are under intensive development and production programs.

The leading contender against the radar threat is the AN/APR 39, Radar Warning Receiver (RWR). The RWR weighs 8 pounds and costs $6,400 per system. Approximately 300 systems have already been delivered and the current total procurement is for 3,000 systems. The RWR is programed for installation on the UH-1H, AH-1, OH-58, CH-47, UH-60, and the Advance Attack Helicopter (AAH). The system is capable of providing both visual and aural signals when the aircraft

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[4] Ibid.

is being tracked by a threat radar. The visual signal indicates the relative bearing to the radar emitter within ±20 degrees. This will provide valuable information to the crew to first, take evasive action away from the threat, and then isolate the location of the threat for possible destruction.

The installation of the RWR is relatively easy and adds very little to the aircraft gross weight. Installation for the UH-1H is seen on Figure K, AH-1G on Figure L, and the OH-58 on Figure M.

Another viable system currently under development is the AN/ALQ 136 Radar Jammer. The first production of this jammer is scheduled for late fiscal year 1978 and the initial models will be placed on the AH-1S. This Radar Jammer is capable of handling two radar threats simultaneously and defeats these radars by returning the indications of multiple targets. By doing this, the threat radar must interrogate each target individually, in an attempt to determine which one is real. The operation of the jammer is extremely simple. The only indicators for the system are overheat and inoperative, if both those lights are out, the jammer is operating normal.

As previously mentioned, the XM-130 flare and chaff dispenser is being considered as a possible survivability system. The cost per system is approximately $6,000 each,

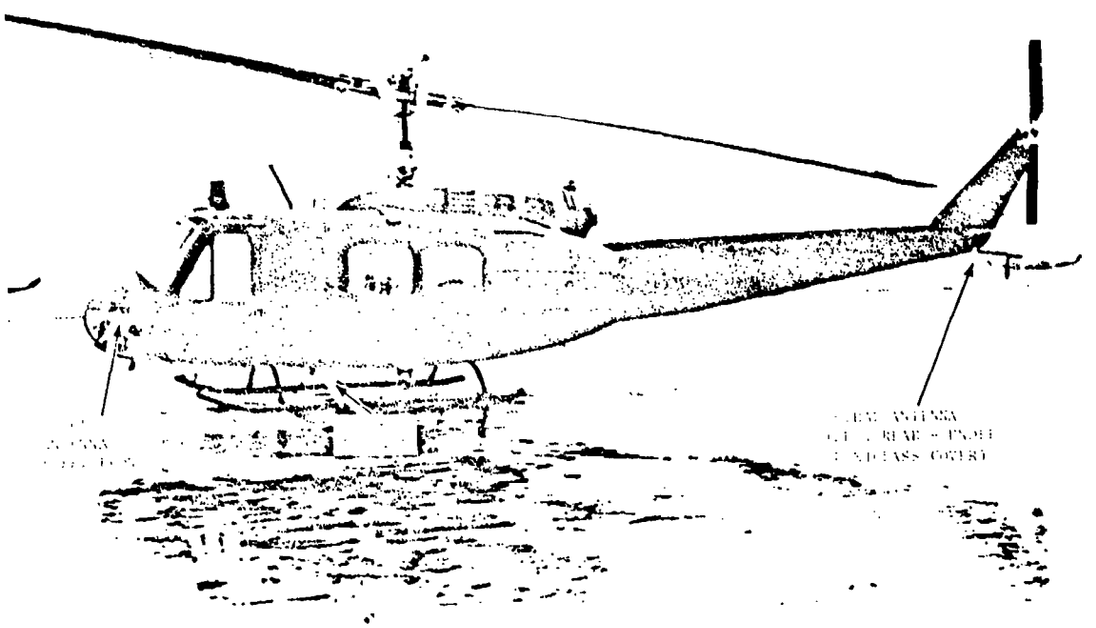

Figure K. (U) AN/APR-39(V)1 Installation on UH-1H Aircraft

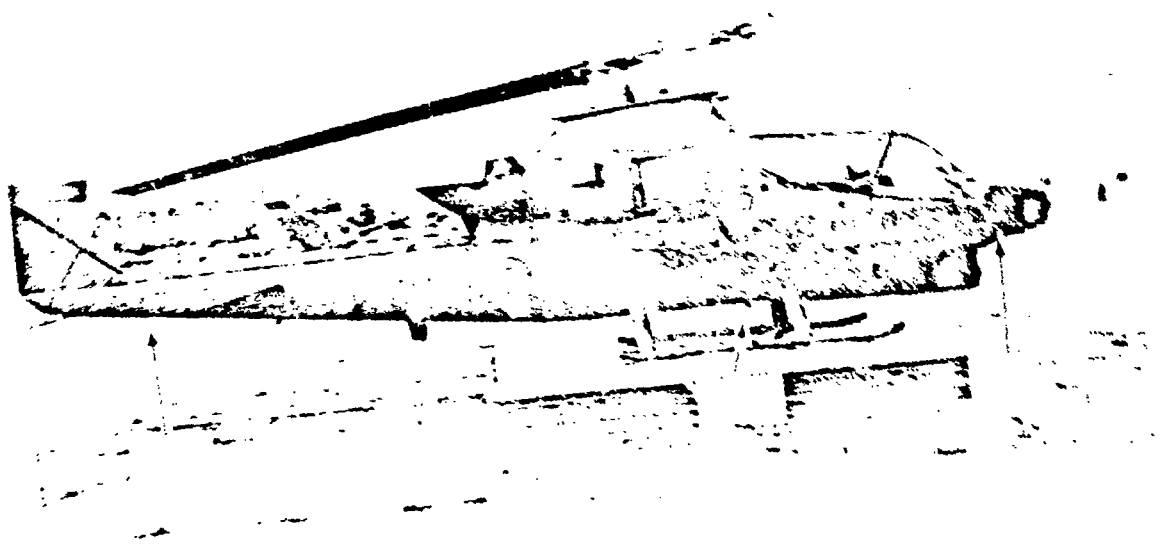

Figure L. (U) AN/APR-39(V)1 Installation on AH-1G Aircraft

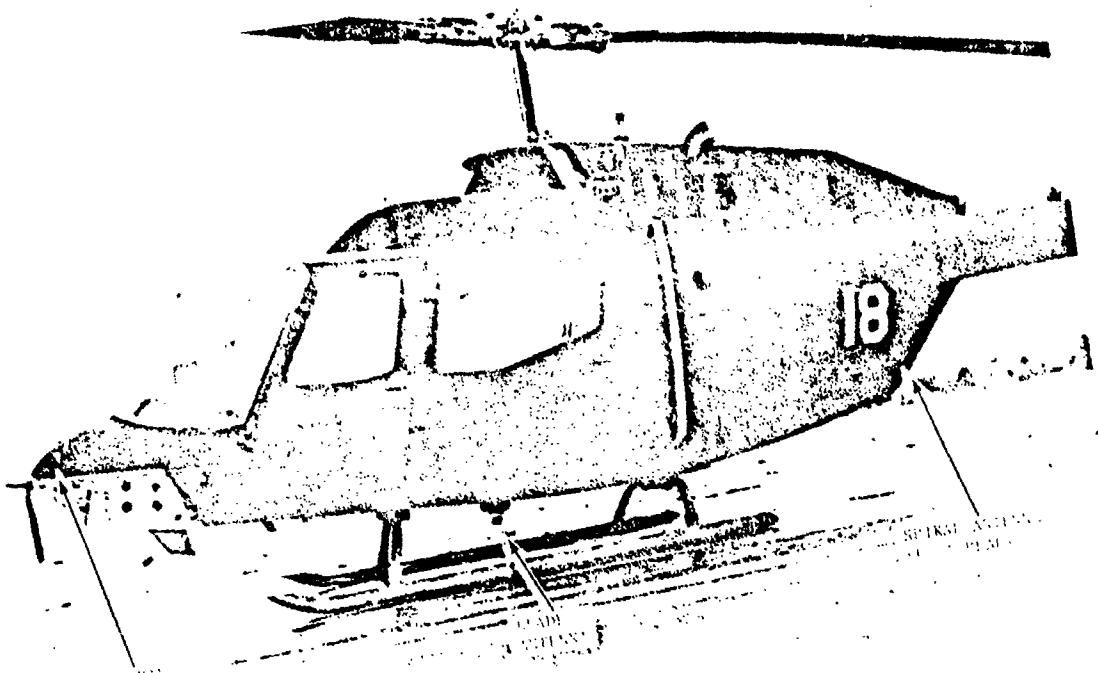

Figure M. (U) AN/APR-39(V)1 Installation on OH-58 Aircraft

with a total buy of 320 units. The system can dispense both flares and chaff cartridges on the same mission. The pilot can select the number of cartridges to be fired or the entire load may be fired in salvo (ripple fire), if required; and, it takes less than one-half a second for a single chaff cartridge to create a signature 2½ times greater than a UH-1H. The most advantageous use of the chaff cartridge is after the Radar Warning Receiver has signaled a threat radar is tracking. The return signatures would be confusing to the radar particularly if several cartridges were fired and a large portion of the radar screen was blanketed. Of course, this would allow the helicopter to escape to safety and continue its mission.

Besides the XM-130 dispenser, a 2.75-inch smoke and chaff rocket is currently being developed. A single chaff rocket contains 44 million dipoles which reflect the radar waves and provide a false target. The desired use of this rocket is similar to the dispenser, in that it can decoy the radar, thus requiring timely interrogation to locate the real target. The single disadvantage of this rocket is that it requires the use of a hard firing point on the attack helicopter, this reduces the number of firing points available for anti-tank missiles and other destructive rockets.

Passive systems influence the prospective air-to-air weapons systems in two areas. First, the increased weight

of the passive system will decrease the useful carrying capacity of the helicopter. Gross weight is described as the maximum total weight at which an aircraft is capable of normal flight, and useful weight is figured from gross weight by subtracting the total weight of all aircraft systems. The addition of these systems will limit the available useful weight for offensive and defensive weapons, but their presence must be considered essential to surviving on the battlefield.

Second, air-to-air weapons are similar to ground air defense weapons, in that, many of these missiles are infrared/heat seekers and many guns are radar tracking. In this situation the passive systems may provide a dual capability, a goal which is often sought but hardly ever reached. The ability to be warned of an enemy and to decoy an attacker whether on the ground or in the air, is a significant achievement on the battlefield.

Survival on the battlefield is the ultimate goal of the passive systems. But, if in order to survive, one evades and fails to destroy the enemy, then who is considered successful? The enemy has kept the destructive force from reaching his units and better yet, he is well aware that you pose no threat to him, if and when you meet again. The addition of Aircraft Survivability Equipment is a very important ingredient in the total system in combat helicopters, but it fails to provide the assertive tools necessary to

destroy the enemy. Those assertive tools are the active defensive weapons and the precise combination of both systems will provide the flexibility required in a fluid combat situation. Chapter V will explore the weapons available for this self-defense role.

CHAPTER V

ACTIVE DEFENSIVE SYSTEMS

As explained in Chapter IV, passive defensive systems are capable of providing increased helicopter survivability against surface-to-air and infrared anti-aircraft weapons systems. But this capability requires that the aircraft be diverted from its original mission and in order to survive, by requiring the aircrew to take evasive actions to a safe location. If the enemy weapons miss their mark, then success could be measured by the enemy's ability to degrade the aircrew's performance to accomplish their assigned mission on the battlefield. This degradation can be accomplished in several ways, such as, the use of electronic warfare (jamming, etc.) or perhaps through the use of air defense weapons and ultimately with the HIND attack helicopter. Electronic warfare and air defense weapons can be overcome and pose relatively little threat beyond their original intent. But the HIND attack helicopter is not only capable of clearing the battlefield of our helicopters, but if left unchecked, can play havoc with ground maneuver forces at every echelon. The ability of U.S. attack helicopters to remain in combat and influence engagements with enemy forces will depend on the active defensive weapons used in

conjunction with the passive systems discussed. An active defensive weapon is defined as an armament designed to disable or destroy an enemy threat, used strictly from a self-defense posture in which its use requires an immediate response for survival.

Historically, military weapons evolve from the needs to destroy a given threat or enemy capability. In developing a weapon and bringing it into the military inventory certain procedures must be examined in the material acquisition process.

"Below the DA level there are two principal implementors in the material acquisition process--the combat developer and the material developer. The combat developer is the command or agency responsible for the formulations of concepts, doctrine, organization and material objectives/requirements for the U.S. Army. The material developer is the command or agency responsible for research, development, production validation and procurement of a system."[1]

Before a weapon can be developed and produced, the combat developer (the user) and the material developer must investigate the material concept. For the user, it may be a requirement to counter a validated threat, or correct an operational inadequacy in existing material or to exploit

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[1]Department of the Army, U.S. Army Command and General Staff College, The Materiel Acquisition Process, Course A452 (FY 1977-78), p. M1-28.

a technological breakthrough. For the material developer, the material concept investigation could be the result of an advancement in technology or an effort to reduce a high consumption of vital or scarce resources. In either event, it is imperative for both the user and the developer to coordinate and establish a Letter of Agreement (LOA) to define the thrust of the new development, to organize the concept and finally agree on the basic details of what is to be developed. This insures that the development effort provides the soldier with a useful and reliable weapon that has been developed and tested along strict criteria.

The current Letter of Agreement (LOA) for the attack helicopter self-defense system is under consideration and awaiting approval. Three important paragraphs which pave the way for air-to-air weapons for the present and in the future are: (1) need for a system; (2) operational concept; and (3) system description.

1. NEED FOR A SYSTEM.

a. A self-defense system is currently needed for present and follow-on attack helicopters to defend themselves against armed hostile aircraft. Such a system is required for all phases of worldwide attack helicopter team operations. The air defense threat projected for future mid-to-high intensity war will require that Army attack helicopters operate at nap-of-the-earth (NOE) to survive. Compounding this threat will be the presence of enemy attack helicopters. The US attack helicopter's primary mission of supporting the ground commander will be degraded when this air threat is present. Under these circumstances, US Army attack helicopters will require the means to destroy or suppress this threat to successfully accomplish their

mission. A system is needed now for the AH-1S and for the Advanced Attack Helicopter when fielded.

2. OPERATIONAL CONCEPT.

The primary role of the attack helicopter on the battlefield is destruction of enemy tanks. Presence of enemy attack helicopters may prohibit friendly attack helicopters from accomplishing their primary mission. A self-defense weapon system must be available to eliminate the enemy attack helicopter threat. A helicopter air-to-air engagement will normally be abrupt, requiring immediate response to the threat. The attack helicopter self-defense weapon system will be used when friendly air and or air defense, systems are not sufficiently responsive. Basic tactics for the attack helicopter primary mission are sound for the air-to-air engagement. Since the attack helicopter operates within the ground environment (NOE) the same actions upon contact for ground vehicles are applicable for the attack helicopters.

3. SYSTEM DESCRIPTION.

The system should make maximum use of existing equipment. For short ranges the system could be the 20/30-mm cannon with an adequate fire control for air-to-air engagement. Longer ranges require a missile system (TOW, HELLFIRE, REDEYE/STINGER). The system must have appropriate indicators to display the status of the system and provide an immediate fire capability after the target tracking mode has begun. The system should preclude easy countermeasure degradation. It should be compatible with aircraft design and operational criteria.[2]

While the Letter of Agreement is waiting to be finalized, the U.S. Army has announced it would be heading a joint service evaluation aimed at developing air-to-air combat tactics for attack helicopters. The impetus for this joint effort, called Air Combat Engagement (ACE), has come

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[2]U.S. Army Materiel Development and Readiness Command/ U.S. Army Training and Doctrine Command. "Letter of Agreement (LOA) for an Attack Helicopter Self-Defense System." Alexandria, VA/Fort Monroe, VA., [10 March 1976].

from assessments of the aerial combat potential seen in the Soviet's MI-24 HIND attack helicopter. ACE will attempt not only to define the air combat tactics and attack helicopter needed for it, but also determine the armaments required for that role.

With this increased interest by all the services in the air-to-air role of helicopters, it has become apparent that an examination should be made as to what weapons are presently available to achieve the desired results. This thesis examination will include both the gun systems and the missile systems currently in the weapons inventory and presently under development.

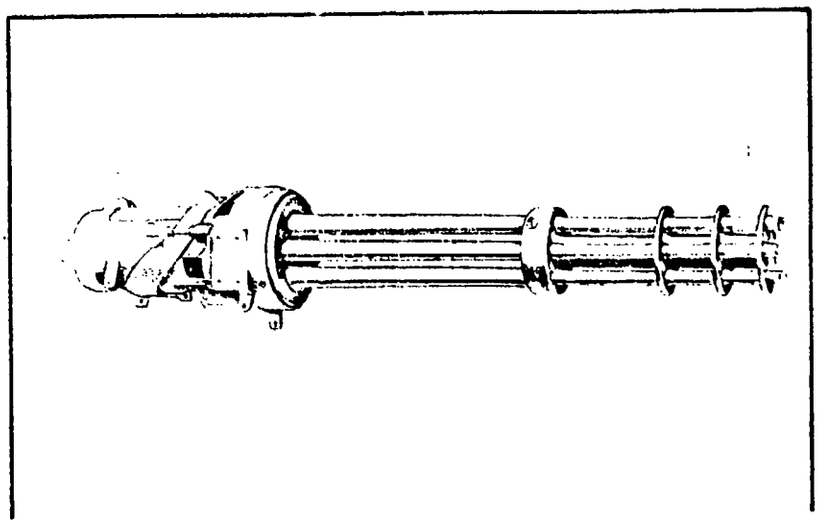
The gun systems include the XM230, 30-mm chain gun, XM140, 30-mm automatic gun, XM197, 20-mm automatic gun, XM195, 20-mm automatic gun, M134, 7.62 machine gun (high rate) and the XM214, 5.56 automatic gun. The advantages of a gun weapon system are significant with respect to the nap-of-earth (NOE) environment and current helicopter employment techniques. Mainly, a gun mounted on a turret has the capability to fire at a target which is off center of the aircraft axis. This allows the aircraft to continue a desired flight path and still engage targets right and left of its course. In the NOE environment, greater potentials exist that a helicopter enroute may confront an enemy helicopter and not have sufficient time to change directions of flight to engage the adversary. For this type of close-in

engagement a flexible gun is best suited, because of its ability to attain high rate of fire quickly, and provide very fast movement to align on the target. Additionally, a flexible gun can be used as an area weapon to service various other air-to-surface targets besides providing this valuable air-to-air defense.

The smaller caliber weapons, such as the M134, 7.62 machine gun (high rate) and the XM214, 5.56 automatic gun, must be eliminated because the Letter of Agreement in the system description has stipulated a 20/30-mm gun. This material need is based of the effective range required for such a weapon and the ability of the ammunition to damage an aircraft upon impact. The M134 and the XM214 (Figure N) provide approximately 1,500 meters effective range and are limited in aircraft hit results, both characteristics are less than the requirements as stated in the LOA.

The larger caliber weapons available are the XM140, 30-mm automatic gun and XM230, 30-mm chain gun. They provide several benefits including greater range, increased lethality against aircraft, a high-explosive round, an armor piercing capability and the flexibility to be used against both air-to-air and air-to-surface targets.

The XM140 (Figure O) is a light weight 30-mm automatic gun capable of a maximum range of 3,000 meters at 8° elevation with a muzzle velocity of 2,200 feet per second (FPS). The weapon weighs 140 lbs and can attain a rate of fire at



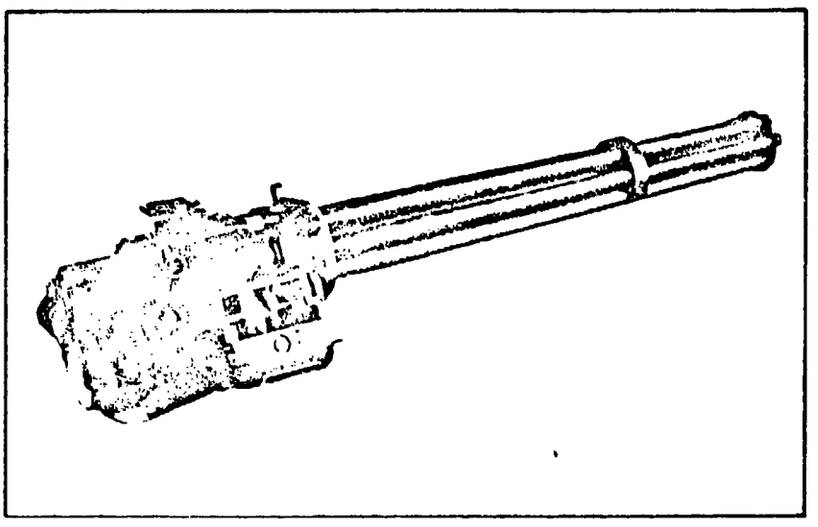
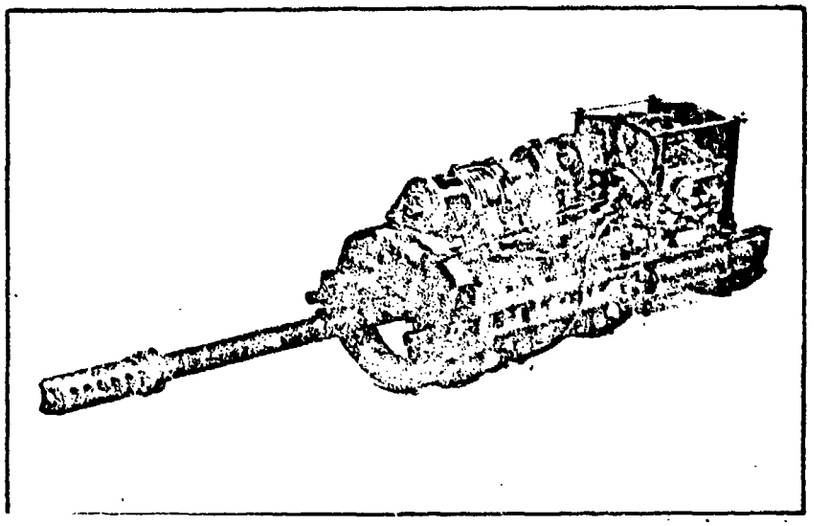


Figure N. (Top) M134 Machine Gun, High Rate, 7.62 MM
(Bottom) XM214 Automatic Gun, 5.56 MM



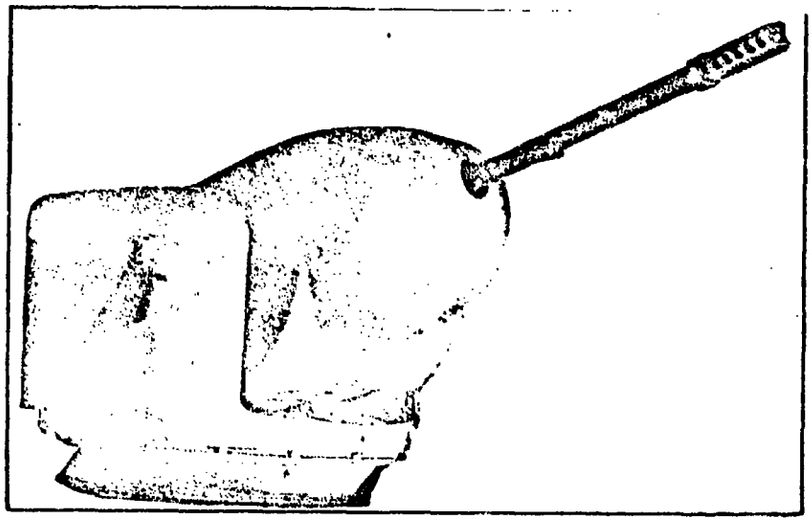


Figure 0. (Top) XM 140 Automatic Gun
(Bottom) Armament Subsystem,
30MM, Automatic Gun

405 shot per minute (SPM). But when this weapon is applied to the XM120 subsystem, hydraulically powered turret (Figure O) the weight increases to 937 lbs and the rate of fire is reduced to 300 SPM. The complete XM120 subsystem contains the XM140, 30-mm automatic gun, turret assembly, turret control box, gun control box and the ammo feed system, all of which are designed to be mounted in the nose of the AH-1G helicopter.

CHARACTERISTICS

AMMO Capacity:	500 rds
Weight:	937 lbs
Max Range:	3,000 meters
Muzzle Velocity:	2,200 FPS
Rate of Fire:	300 SPM
Elevation:	+15°; Depression: -40°
Traverse:	110° right and left of longitudinal axis
Sighting:	Modified XM26 TOW missile sight or advanced fire control consisting of a stabilized optical sight, laser range finder, ballistic computer, and helmet sights.[3]

The weight of this system seems to reduce it from being considered as a viable candidate, particularly when the rate of fire is also restricted in this configuration.

The most promising 30-mm weapon seems to be the XM230 chain gun (Figure P). This gun is a single barrel,

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[3]Department of the Army, U.S. Army Weapons Command, Aircraft Armament, Rock Island, IL: December 1971, p. 18.

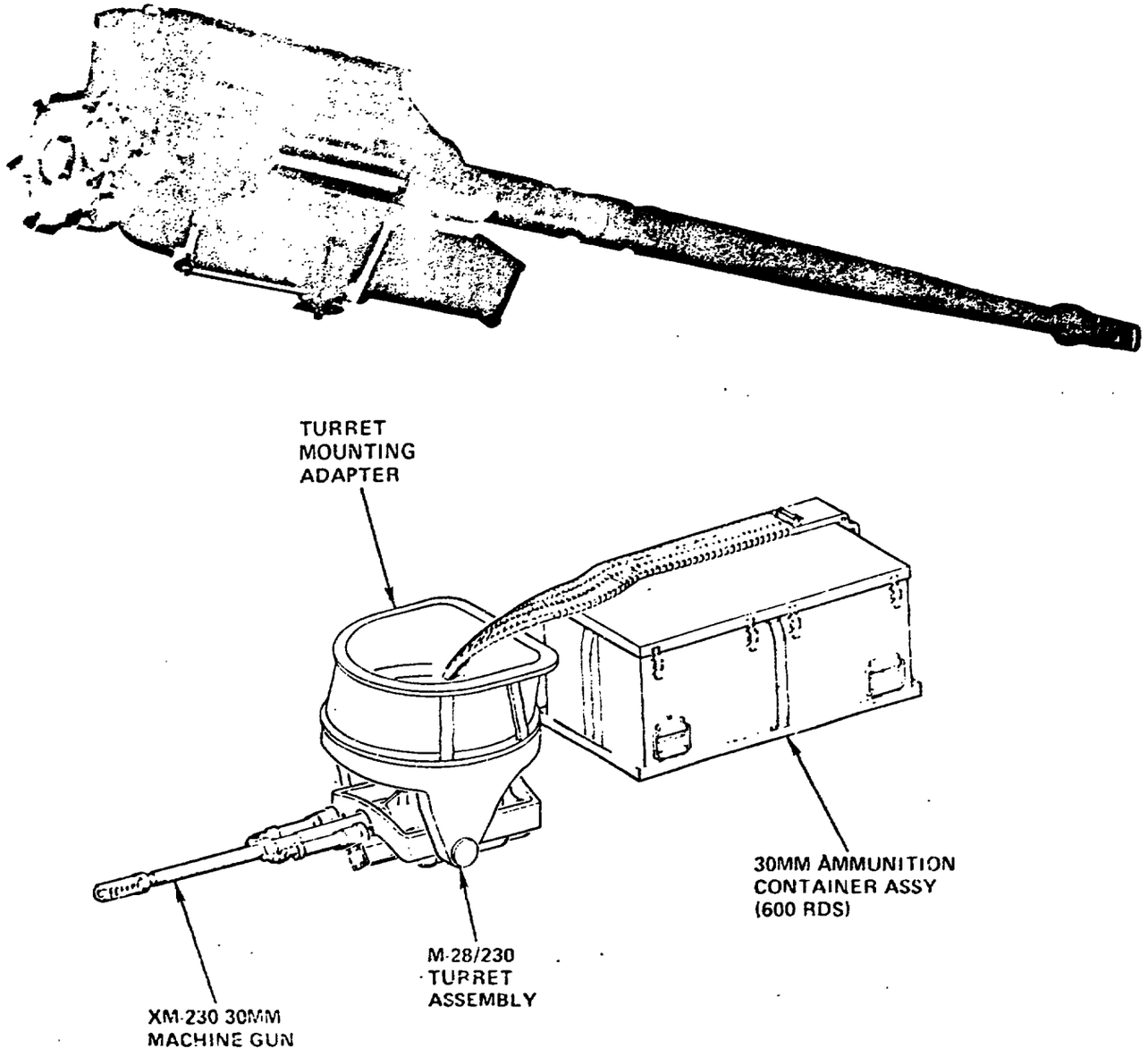


Figure P. 30 MM Chain Gun

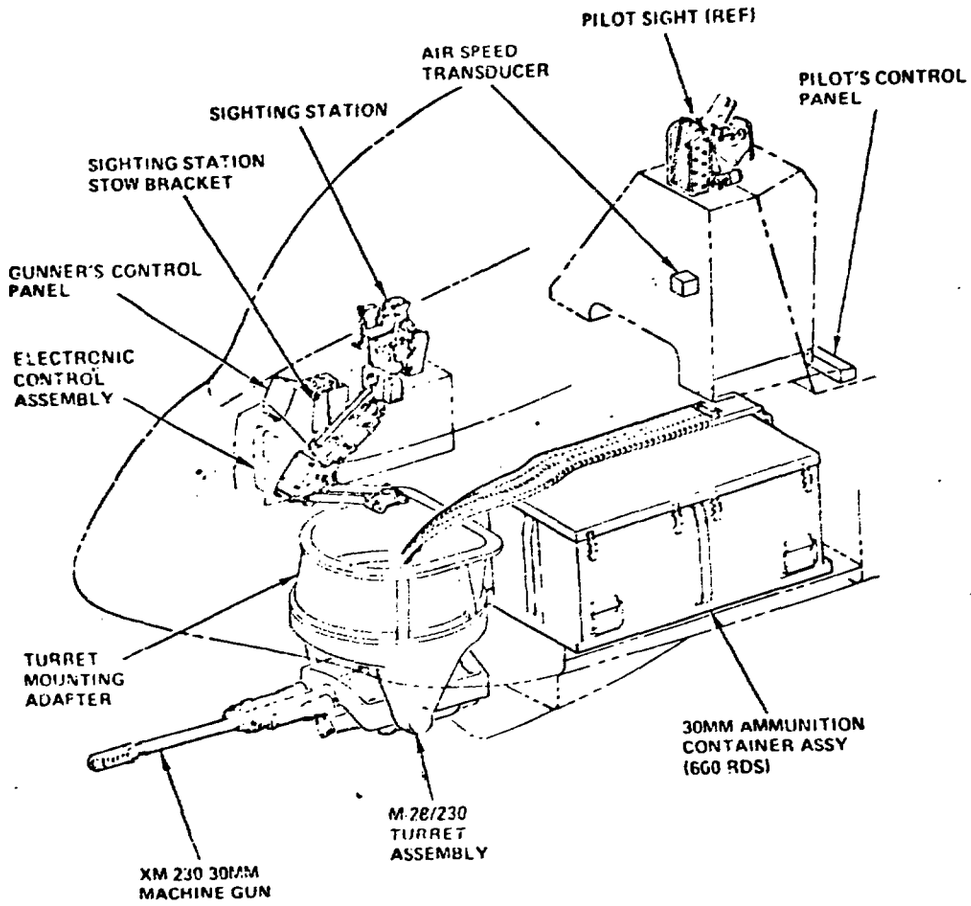
externally powered weapon which incorporates a rotating bolt mechanism driven by a simple chain drive. The gun weighs approximately 98 lbs and fires at a rate of 620 ±50 shots per minute. The firing rate can be easily adjusted to match the natural frequency of the AH-1 helicopter by adjustment of the external power source. The chain mechanism, together with its simplified feeder, assures high reliability at all rates of fire. Because of the guns simplicity, production costs are expected to be comparatively low to other 30-mm weapons. This weapon is currently under development and will be available in May 1981.

The characteristics table (Figure Q) and the proposed armament system (Figure R) were provided by Hughest Helicopter and Ordnance Systems and Emerson Electronics and Space Division.

The 20-mm weapons available are the XM195 and XM197 20-mm automatic guns. The XM195 (Figure S) has been integrated into the M35 subsystem, which uses the 20-mm Gatling gun mounted on the inboard station of the left hand wing of the AH-1G helicopter. This fixed position on the aircraft severly limits the functional capabilities to use the XM195 in an air-to-air role. On the other hand, the XM197 (Figure S) is being fitted to a flexible turret capable of providing off axis firing. This weapon is a 3 barrel, Gatling type gun which fires both, armor piercing incendiary and high explosive incendiary ammunition.

Caliber	30mm
Ammunition	
Combat	XM552 HEDP
Practice	XM639
Weight	
Receiver (with motor and feeder)	58 lb
Barrel (with recoil adapters)	40 lb
Total gun system weight	98 lb
Dimensions	
Length	63.0 in
Width	8.9 in
Height	8.5 in
Frontal area	57 sq in
Parts count	149
Barrel life	To 20,000 rounds
Rate of fire	Single shot to 600 SPM
Time to rate (at 600 spm)	0.12 sec
Time to stop (at 600 spm)	0.10 sec
Clearing method	Open bolt
Dispersion	1 mil (1σ)
Power required	3.5 hp
Reliability predicted	25,000 MRTF

Figure Q. XM-230 Vehicle Chain Gun Characteristics



CHARACTERISTICS

WEAPON – 30MM XM 230

FIRING RATE – 600 SPM

AMMO CAPACITY – 600 RDS

WEIGHT (LESS AMMO) – 331 LBS

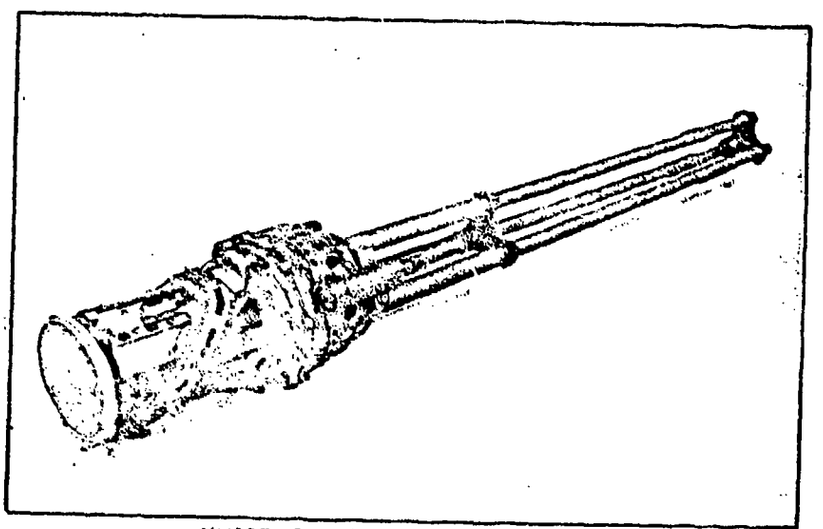
FIELD OF FIRE – AZ $\pm$ 110°

EL + 15°
– 45°

DRIVES – HYDRAULIC
(SAME AS M28A1)

Figure R. The 30MM Chain Gun System and Characteristics

M35 Armament Subsystem, Helicopter, 20mm Automatic Gun



XM197 Gun, Light, 3 Barrel, 20mm

Figure S. M35 Armament Subsystem, Helicopter, 20MM Automatic Gun and XM197 Gun, Light, 3 Barrel, 20mm

The flexible turret system to be utilized on the attack helicopter must provide not only off axis fires, but should not reduce the desired capabilities of the gun or significantly increase the total weight of the system. The M-28 turret assembly is designed for other weapons which may not contain the benefits required for the air-to-air gun and the Navy's nose turret for the AH-1J would not be compatible with the Army's desire to actively pursue the system from existing equipment as procured for Army use. However, the Navy's turret is a possible solution to the problem, but does not allow other weapons systems, such as the 40 mm, to be accommodated on the same mount. Interchangeability of systems is a very important feature when considering particular weapons tailoring for specific missions or mixing attack forces and the loss of that capability directly influences the flexibility of an organization to adjust to a given situation.

CHARACTERISTICS

Application:	Nose turret for AH-1J (Used only by US Navy)
Barrel Length:	60 inches
Overall Length:	72 inches
Weight:	146.2 lbs
Muzzle Velocity	3,400 FPS
Firing Rates:	400-1, 500 SPM
Peak Recoil Forces:	2,600 lbs
Power Required (Firing Circuit):	250-300 Volts, D.C., 0.5 Amp[4]

The gun systems which are able to meet the requirement as stated in the Letter of Agreement can be identified as the XM197, 20-mm and XM230, 30-mm. First, both guns make maximum use of existing equipment. Second, both provide coverage for short ranges. And last, both guns are compatible with aircraft design and operational criteria. The significant difference between these two weapons are the turret systems by which they are attached to the aircraft. The XM197 has been applied to a nose turret used only by the U.S. Navy and the XM230 is applied to a M-28 turret assembly which is designed for other weapons. To resolve this problem a Special Study Group, during the Priority Aircraft Subsystem Review at Fort Rucker, Alabama, defined the requirement to modernize and "upgun" the AH-1 Cobra. Phase I of this effort includes the development of a universal turret (Figure T) to accommodate either the 20-mm or 30-mm weapon system.

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[4]Ibid., p. 24.

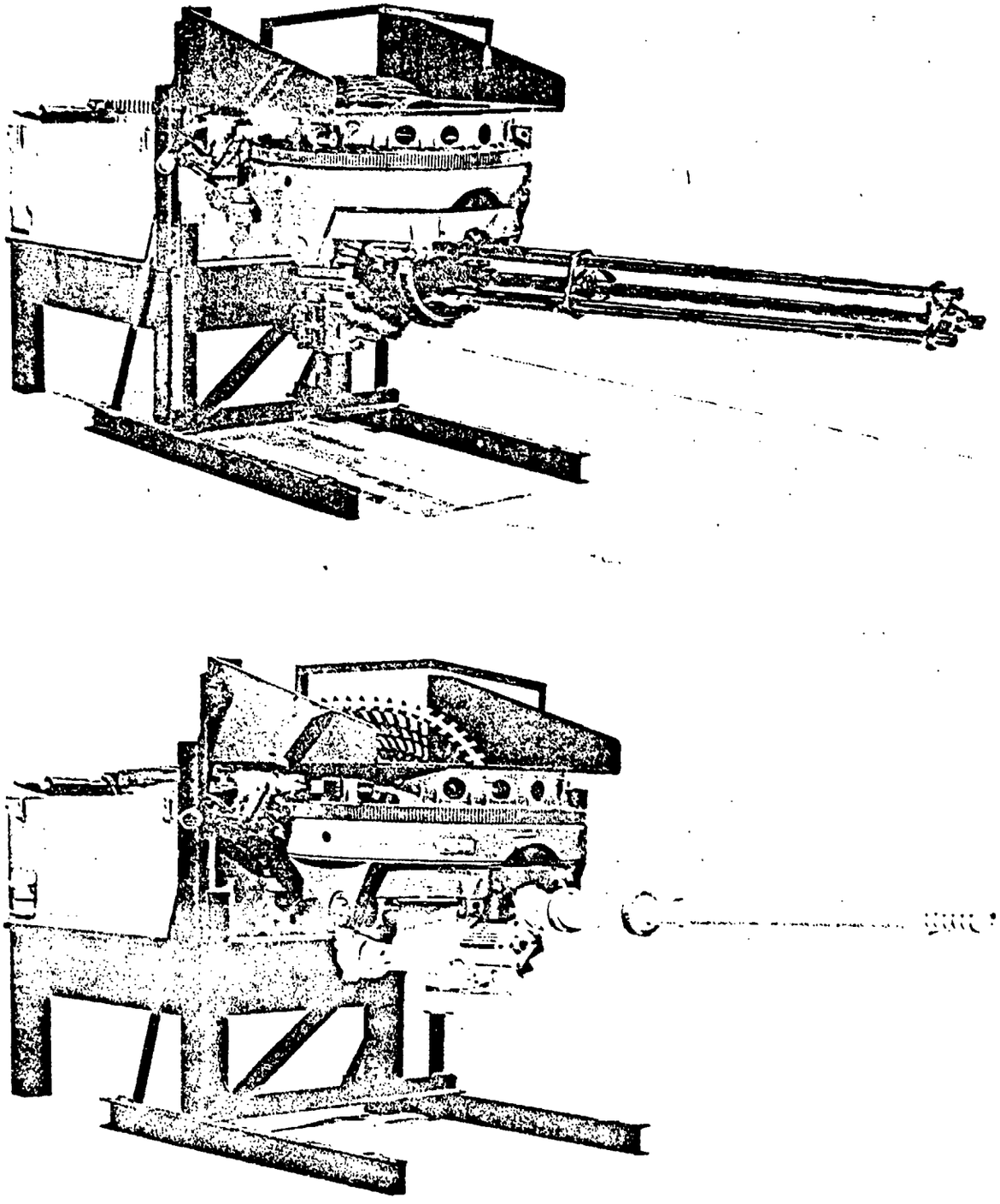

Figure 7. XM 230E1, 30MM Chain Gun with Ammunition Container Mounted in the Universal Turret

> The universal turret will be developed and manufactured by General Electric, Armament Systems Department, Burlington, VT. The objectives of the Universal Turret Program are to provide an improved standoff capability, improve antipersonnel and antimateriel effectiveness and accommodate either a 20-mm or 30-mm weapon. This new turret eventually will replace the M28 (7.62 mm/40 mm) subsystem now installed in the Cobra.[5]

The universal turret will enhance the development of future weapons systems by providing the standard point from which design will commence. Additionally, the testing weapons to determine the best system will be limited to the gun itself and will not require major aircraft engineering changes and modifications. More importantly, the logistics commonality and interchangeability of the guns will provide the helicopter units maximum flexibility and maintainability of these sophisticated systems.

MISSILES

As we examine the candidates for an air-to-air missile system, three factors must be recognized. First, the LOA stated in the system description that the longer ranges require a missile such as, the TOW, HELLFIRE or REDEYE/STINGER. Second, the U.S. Army presently has no air-to-air missile capability from which to build upon. And third, the missile system should preclude easy countermeasure degradation. Each of these factors will influence the final

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[5]Colonel Robert P. St. Louis, "Modernized Cobra," U.S. Army Aviation Digest, February 1978, p. 20.

selection or rejection of a candidate.

Additional considerations include range, speed and weight of the missile system. The ultimate evaluation will be the missiles ability to perform in a multi-role, and do so effectively within acceptable parameters. The latter is perhaps why the TOW (tube-launched, optically-tracked, wire-guided missile) and HELLFIRE anti-armor missiles are considered as candidates for air-to-air roles.

Let us first examine the TOW, (Figure U) which is currently in the inventory and is the U.S. Army's primary anti-armor missile. The TOW missile is capable of subsonic speeds to a range of 2.3 miles.

"The system's optical sighting device permits operation by one man. Basically, the operator keeps the target centered in the lens cross hairs. As the sight is moved to track the target, sensors translate the movements to electrical pulses which are fed into a computer which, in turn, automatically determines range and aximuth for firing. The launch sequence is in two phases. A solid motor is used to eject the missile from the tube at a safe distance from the operator before the in-flight motor is ignited. The computer continues to monitor inputs from the sensors regarding sight changes and feed course corrections directly to the missile via two hair-thin wires which are

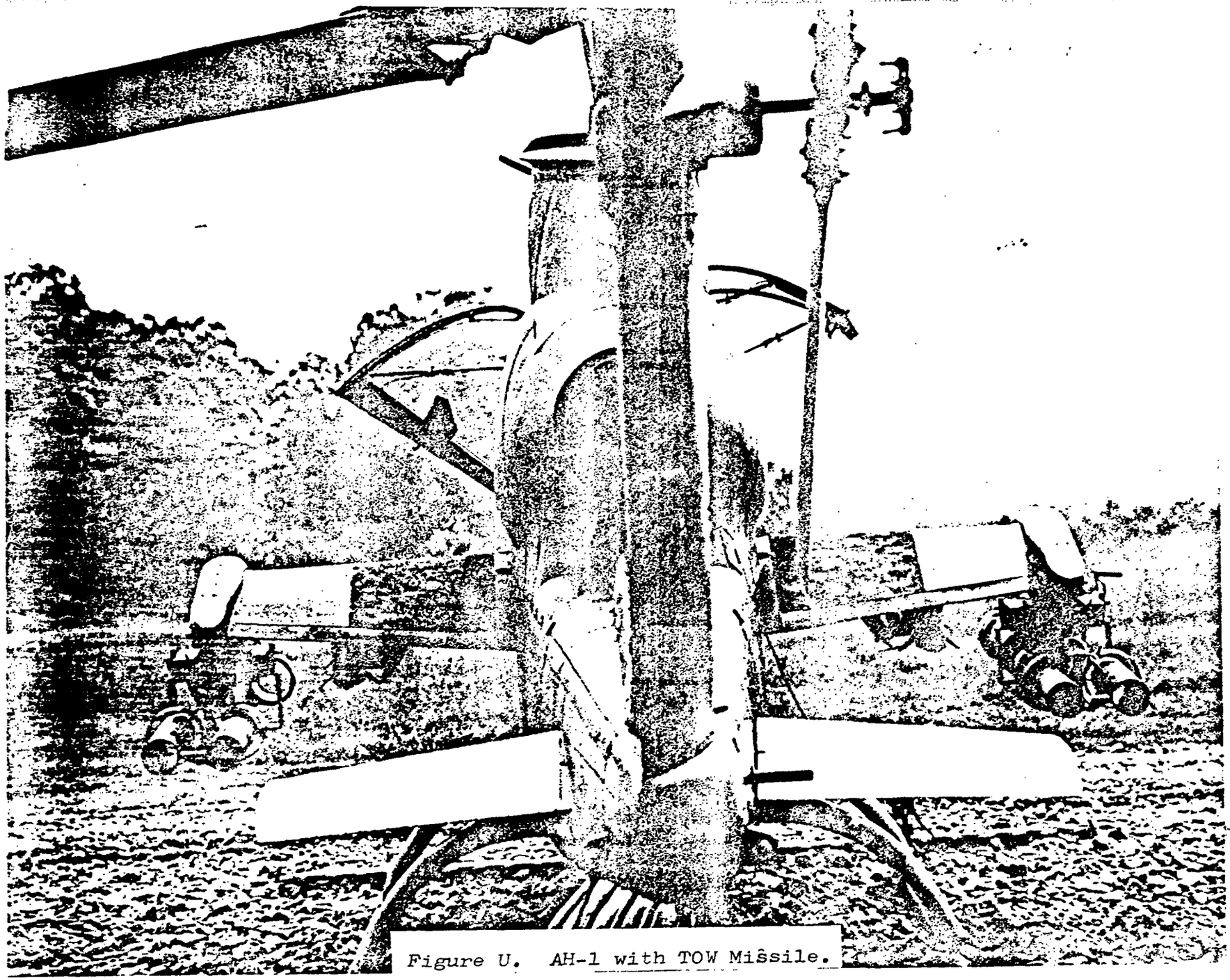

Figure U. AH-1 with TOW Missile.

unreeled at high speed off a spool mounted on the launcher."[6]

To use a TOW missile requires the operator to stay on target until impact. This presents a significant problem because the missile time of flight is slow enough to allow the air adversary to engage the launch platform before the missile impacts. Additionally, the launching and tracking will require the helicopter to be aligned and remain so until impact. The vulnerability of the aircraft during this sequence may not provide a satisfactory environment for a self-defense engagement. The exposure of the helicopter and the subsonic speed of the missile are the major disadvantages of the TOW system in the air-to-air role.

Currently under development is the HELLFIRE missile system (Figure V) the performance characteristics are classified, but are generally better than the present TOW system. The greatest advantage of this system is the capability to launch the missile and track it to the target in several modes. One tracking mode is by a coded laser beam from the attack helicopter, scout helicopter or a ground designator, thus providing the flexibility to "launch and leave." A second tracking mode is by infrared, which guides the missile to the target on thermal radiation contrast allowing for a "Fire and Forget" situation. And last, the RF/IR mode, which tracks to the target via Radar

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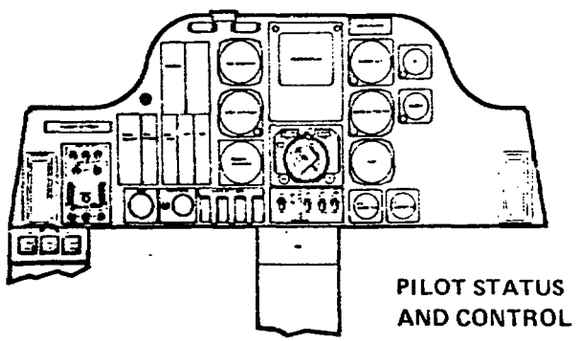
[6]General Dynamics, Worlds Missile Systems, Pomona Division, Publication, October 1975, p. 100.

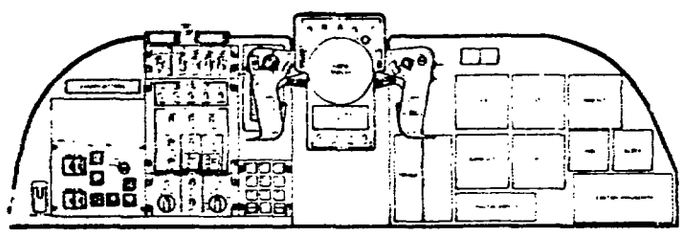
SYSTEM ELEMENTS

HELLFIRE Missile Equipment– Controls, Displays, HISU, and Cabling

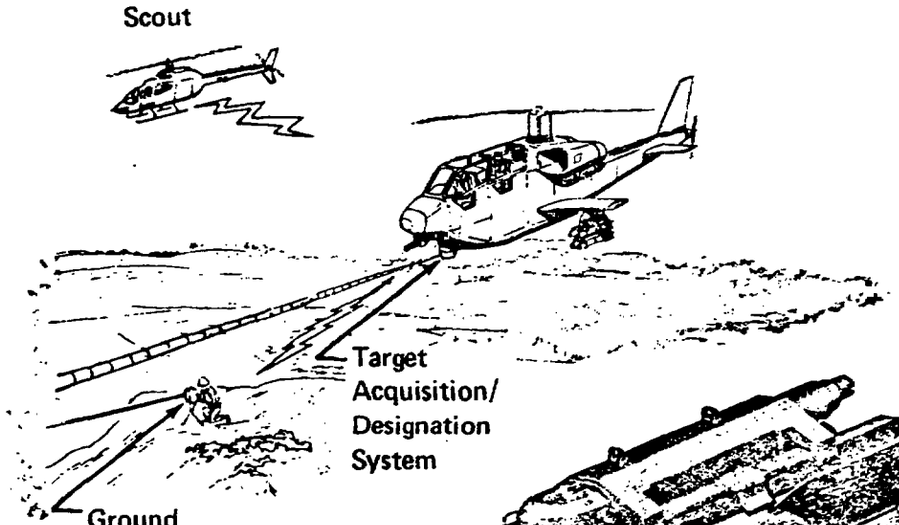
Interchangeable guidance seeker modules contribute to HELLFIRE's mission versatility and operational flexibility. In addition to a helicopter-borne laser missile, the HELLFIRE system incorporates both an airborne designator and a ground laser locator/designator for target illumination.

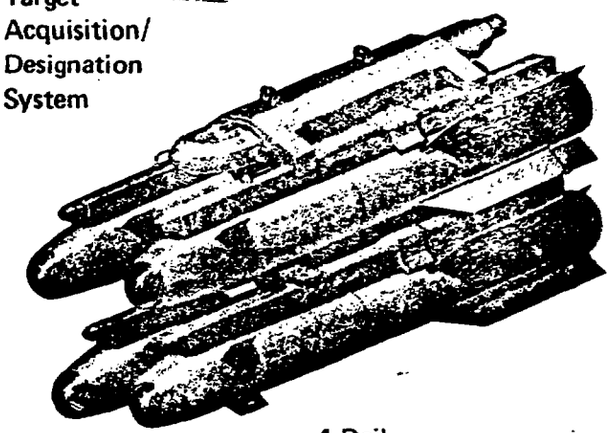


PILOT STATUS
AND CONTROL PANEL



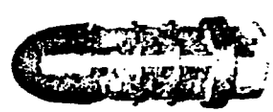
YAH-64 COPILOT GUNNER
CONTROLS AND DISPLAYS





4-Rail
Modular Launcher

SEEKER–SEPARATE PROCUREMENT



LASER

RF/IR

INFRARED

Frequencies, then homes on the infrared (thermal radiation) of the vehicle. All three modes provide great advantages to acquire, launch and move out quickly, particularly in a self-defense posture.

The HELLFIRE can be launched from a covered or hidden position and can engage multiple targets effectively by rapid or ripple fire. Just how effective will this system be against high performance aircraft remains to be evaluated, but it certainly would appear to be effective for close-in helicopter engagements.

The only pure anti-aircraft missile under consideration at this time is the STINGER missile system. The STINGER missile system adapted for a AH-1 helicopter is shown in Figure W. This missile is capable of supersonic speeds up to a range of 3 miles.

"STINGER will eventually replace REDEYE. It will be able to engage aircraft flying up to MACH 1 at all aspects. STINGER has counter-counter measures circuitry providing immunity to any known IR threat. The STINGER also has the capability of challenging aircraft through its IFF interrogator."[7]

The REDEYE missile mentioned above is the current U.S. Army shoulder launched anti-aircraft missile system.

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[7]Ibid., p. 201.

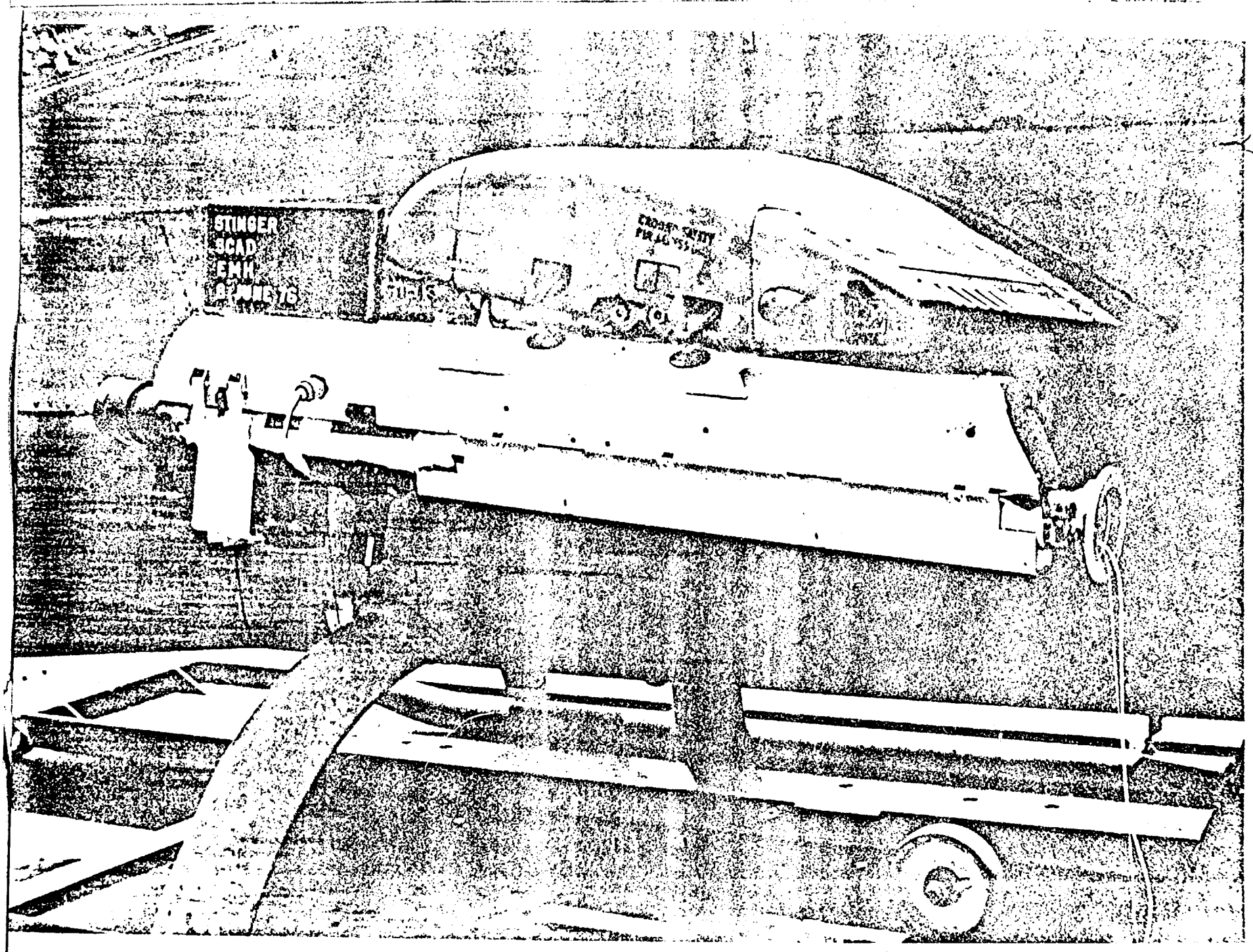

Figure W. The Stinger Missile Mounted on the AH-1 Helicopter.

Also mentioned above, IFF is Identification Friend or Foe electronics on combat aircraft.

This missile system is a "Fire and Forget" system which can provide the long range air-to-air capability sought by the LOA. Of course, the disadvantage is that it is strictly an air defense weapon and capable only of that singular role. Use of the STINGER on the attack helicopter will reduce the anti-armor armament carrying capability as well as the capability to carry other types of armaments.

Just which missile system will get the go-ahead for the air-to-air role is hard to determine. Because of the need for an immediate system, the HELLFIRE is not a viable candidate. However, its future application is extremely good. The TOW has limitations which may not be overcome to warrant its shift to limited air-to-air employment. The STINGER is a very good prospect, with its long stand-off range. To determine which systems are suitable for immediate utilization, actual firing tests must be made and those test results will set the stage for the Army's air-to-air capability.

Having reviewed the weapons systems which are presently available or nearly available from research and development, the next phase of the program will consist of Force Development Test and Experimentation to be conducted in September and October 1978. This type of testing is

conducted to provide necessary information for decision-making.

"Force Development Testing and Experimentation (FDTE) includes innovative and operational feasibility testing and may support the combat and force development and the material acquisition processes by providing essential information at decision reviews. During the conceptual phase of the material acquisition process, FDTE will be used to develop the concept of employment, determine operational feasibility, estimate the potential operational advantage of a proposed system, and assist the combat and material developers in the development of Letters of Agreements. FDTE also supports the material acquisition process by providing data to assist in the development of material requirements documents."[8]

The current test plan, titled "Attack Helicopter Air-to-Air Self-Defense Subsystem Evaluation," has the stated purpose to: "Provide information for a comparative assessment of the TOW, M197 and STINGER weapons subsystems in the air-to-air self-defense role. Data from this live fire comparative evaluation will be used to identify the best available attack helicopter weapons subsystem configuration."[9]

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[8]Department of the Army, AR 70-10, Test and Evaluation During Development and Acquisition of Materiel, 1 January 1976, p. 2-9.

[9]U.S. Army Aviation Center, "Outline Test Plan-Attack Helicopter Air-to-Air Self-Defense Weapons Subsystem Evaluation," Ft. Rucker, AL: 19 August 1977, p. 1.

The test plan objectives are:

"Objective 1: To evaluate the operational effectiveness of the M-65 TOW, M-197, 20-mm and STINGER missile system in an air-to-air self-defense role against an appropriately configured aerial target.

"Objective 2: To identify the better of three competing weapon subsystems in terms of overall air-to-air self-defense engagement capability against an attack helicopter air-to-air threat.

"Objective 3: To evaluate each of the competing weapons subsystem's contribution to an integrated self-defense air-to-air engagement weapons system.

"Objective 4: To provide data on which to evaluate the impact of the candidate weapons subsystems on current attack helicopter tactics and doctrine."[10]

This test plan was to be executed from 1 April 1978 to 30 April 1978. However, test equipment and other resource requirements forced a five to six month delay in the program.

The scope and tactical context of the test are the following:

"The FDTE will consist of a live fire comparative evaluation of the M-65 TOW, M-197, 20-mm with a prototype level 5 fire control system and aircraft mounted STINGER missile system. This test will be designed to evaluate all three weapons subsystems independently against a

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[10]Ibid.

simulated threat helicopter aerial target." It will additionally provide data on which to evaluate overall weapons subsystem integration in order to identify a practical affordable air-to-air self-defense engagement capability."[11]

Although the tests will not have commenced before this thesis is completed, certain hardware answers can be deduced. The first is the M65 TOW, M197 and the STINGER missile are the systems to be tested, and must be considered as the weapons which can be fielded immediately. Second, in directing attention to the best performance against an attack helicopter air-to-air threat implies less concern for the high performance aircraft threat. And third, practical affordable air-to-air self-defense engagement capability indicates that system costs may drive the program selection. And last, because of the costs involved, a system which can be used in other roles will provide a higher cost/benefit as opposed to a single role weapon.

In Chapter VI, an examination will be made of all finding of this thesis. This will be an attempt to tie the future air-to-air hardware requirements with the recently completed classified air-to-air testing. A classified Appendix will be added to this thesis to support the findings, as well as, supporting the conclusions and recommendations in Chapter VII.

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[11]Ibid., p. 2.

CHAPTER VI

DISCUSSION OF FINDINGS

In the previous chapter an examination was made of the weapons systems available for use in an air-to-air role. Which system or systems will eventually be selected and employed remains to be determined. However, other questions can be developed and addressed from past research and testing, as well as, current emphasis and influence from the development community. Such questions as, which systems can be fielded immediately? As a factor of this immediacy, which systems are considered viable to warrant testing? Which systems provide the best coverage and flexibility for close-in engagements? Which can be effective against high performance aircraft? What system can be employed as not to allow unnecessary exposure and increase the vulnerability of the launching aircraft? Which is the best "fire and forget" system? Is there a system best suited for multi-employment, in both the air-to-surface or air-to-air roles. Which system or systems will provide the best evolutionary platform for future development and improvement? All these questions can provide the mind-set, which when carefully and systematically answered, will blueprint the air-to-air hardware of the future.

Before attempting to evaluate each of the preceding questions, it is necessary to reestablish the need for an Air-to-Air Weapons System. The need for a system is based on a threat and in this particular situation the Soviet HIND combat helicopter is the validated threat. The capabilities of HIND and the HIND-variant models make it a versatile weapons platform, as previously discussed. The Air-to-Air Weapons Systems will counter this threat and insure the attack helicopter can remain unmolested on the battlefield. Without these air-to-air systems, our helicopters will be denied accessibility to enemy targets to accomplish their missions. This self-defense capability is, in many respects, parallel to the gas mask for infantry soldiers. This protective mask insures that the infantry can fight while under a gas attack. Their fighting mission, like that of the attack helicopter, can still be accomplished and not disregarded through self-preservation actions. The air-to-air helicopter weapons need is valid and the HIND helicopter threat remains ominous without such a capability.

To a lesser degree, the threat from enemy high performance aircraft does exist. In view of the low probabilities of occurrence, the need for an air-to-air system specifically for this threat, does not provide the necessary impetus for such a weapons development. Indeed, the previously discussed evasive maneuvers and actions of the helicopter can be very effective against these Fast Movers.

Thus, the need for a high performance Air-to-Air Weapons System would only be as an outgrowth from either, the additional capability of an existing air-to-air system or the resultant of a change in enemy doctrine and employment against helicopters. The high performance aircraft air-to-air capability should only be considered when examining the multiple roles of a particular system as an added bonus.

With the current and future operational employment of U.S. and Soviet helicopters, as well as, the increased helicopter utilization and production, will come an ever increasing potential for these unique aircraft to meet in combat. The increased numbers of U.S. helicopters in NATO Forces is being offset to an even greater extent in the Soviet Union. The Soviet domination by saturation doctrine is a valid concept, and numerical superiority must be met with improved technology and hardware.

To survive the battle the attack helicopter must be equipped with Aircraft Survivability Equipment (ASE) and an effective Air Defense System. Aircraft Survivability Equipment will allow the intruder to operate within the enemy's air defense umbrella and the air-to-air weapons will protect him, from aerial attack, thus insuring his mission can be accomplished. The anti-armor mission of the attack helicopter is so vital to the NATO defense, that not providing air-to-air protection will only leave that capability impotent. The equation, stated previously, of

the U.S. Army Cobra Force in Europe equal to 3,500 tanks, is meaningless if these attack helicopters cannot stay and fight, fight outnumbered and win.

In researching the air-to-air documents, one report provides the insight to the rationale for such a role. Thi. document is Interim Note A-67, Classified Confidential, titled, "Comments on the Attack Helicopter in an Air Defense Role(U)."

The unclassified purpose of this report is as follows:

> This report discusses a rationale for combining the mobility and agility of the attack helicopter with the air defense capability of the Surface-to-Air Infrared Homing Missile. U.S. helicopters equipped with REDEYE or STINGER type missiles might be a valuable addition to existing air defenses against an enemy Close Air Support (CAS) threat. In addition, this enhances self-defence capability of the helicopter against enemy Fixed-Wing and Rotary-Wing aircraft would be appreciable.[1]

In addition to this discussion, REDEYE System tests and Self-Defense roles are cited as follows:

> It has been demonstrated that the REDEYE System can readily be fixed-forwarded mounted on the existing pylons of a UH-1B/C and fired successfully against ground targets.[2]
>
> Alternately, or even simultaneously, air-launched REDEYE or STINGER missiles would enable the dedicated Anti-Armor Attack Helicopter (with the TOW missile system) to defend itself from fixed or rotary-wing CAS air cover, including attack helicopters.[3]

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[1]U.S. Army Material Systems Analysis Activity, Comments on the Attack Helicopter In An Air Defense Role(U), Interim Note A-67, August 1974 (Confidential), p. 3.

[2]Ibid., p. 6. [3]Ibid., p. 6.

The air-to-air capabilities of the STINGER missile and the vulnerability/survivability of the air-to-air system are summarized in selected paragraphs provided in classified Appendix I.

Another document which provides valuable data is The Technical Proposal for RAM, CPC 2514. RAM stands for REDEYE Air-Launched Missile and the proposal examines the AH-1G Cobra equipped with two REDEYE missiles.

"The RAM missile is a standard U.S. Army REDEYE missile, modified for air-to-air use."[4]

Data and test results are contained in classified Appendix II.

A follow-on document to the RAM proposal is the STINGER Counter-Air Demonstration(U), Technical Report RF 7T-1. The unclassified objective of this demonstration "was to show that the STINGER missile could be safely and effectively fired from an AH-1G helicopter at an airborne target."[5]

"The STINGER, which is being developed for the U.S. Army and U.S. Marine Corps, evolved from REDEYE, the world's first man-portable, shoulder-fired, IR-Homing Anti-Aircraft Missile."[6]

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[4]General Dynamics, Technical Proposal for RAM, An Air-to-Air Armament System for Attack Helicopters(U), Pomona Operation Publication CPC 2514, December 1970, p. 1-1.

[5]U.S. Army Missile Command, "STINGER Counter-Air Demonstration(U)," Technical Report RF 7T-1, 25 August 1976, Confidential, p. 5.

[6]Ibid., p. 5.

The unclassified conclusion of the demonstration is as follows:

"After the demonstration, the conclusion is that STINGER can be interfaced and safely fired from a hovering AH-1G helicopter with no hazardous effects or missile degradation."[7] Further data concerning the test are contained in classified Appendix III.

The final document which is worthy of mention is the Interim Results of an Effectiveness Analysis of Advanced Attack Helicopter Air-to-Air Defense Weapons (Phase I)(U), Interim Note 120. The purpose of this analysis is as follows:

> The main analysis objective was to determine the relative effectiveness of several candidate air-to-air weapons systems and investigate possible updates to the Advanced Attack Helicopter System. Another objective was to provide an estimate of the effectiveness of present and future Soviet attack helicopter air-to-air weapons.[8]

The summary and observations of this document are very enlightening and are contained in classified Appendix IV.

Classified Appendix V contains data from the "Helicopter, Self Defense Weapon System Briefing" given at Fort

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[7]Ibid., p. 10.

[8]U.S. Army Materiel Systems Analysis Activity, Air Warfare Division, Interim Results of an Effectiveness Analysis of Advanced Attack Helicopter Air-to-Air Defense Weapons (Phase I)(U), Interim Note 120, May 1977, Confidential, p. 11.

Rucker on 9 January 1976. This briefing gives the advantages and disadvantages of candidate weapons systems, as well as the levels for the fire control hardware.

These levels are unclassified as follows:

Level 1: Standard AH-1G Fire Control with no more than 25% ranging error (visual estimate).

Level 2: Standard AH-1G Fire Control with laser rangefinder, with less than 10% ranging error.

Level 3: Improved pilots heads-up display, Fire Control computer, improved sight, with laser rangefinder, with no more than 10% error.

Level 4: Improved pilots heads-up display, Fire Control computer, improved sight with less than 5% error, air data sensor and relative wind sensor.

Level 5: Improved pilots heads-up display, Fire Control computer, improved sight, stabilized laser rangefinder subsystem with less than 1% range error, air data sensor and relative wind sensor.

Recall that the outlined test plan calls for one AH-1 with M-197, 20-mm automatic gun and a prototype Level 5 Fire Control System. The technology for Level 5 has been available for some time.

Of the documents and publications reviewed, one point has consistently surfaced and appears to be fixed in development community. That is, the self-defense weapons are time and time again associated to the attack helicopter and/or

Advanced Attack Helicopter. True, the attack helicopter is the primary member of an attack team but we must consider that the Scout observation helicopter plays both a key communication and vital target acquisition role within this team. What better way to protect the entire team and distribute the weapons load carrying capability than to share these weapons with the Scout. The concern with the loss of anti-armor weapons on the attack helicopter is valid. As shown earlier, when these weapons are replaced with air-to-air hardware the anti-armor capability must diminish somewhat.

The attack helicopter's use of 20-mm or 30-mm gun in both air-to-air and air-to-surface meets the multi-role capability, so often desired. These gun systems provide the necessary self-defense for close-in, spontaneous air-to-air engagements. The gun capability is ideal for the attack helicopter without degrading the tank killing potential of the team.

The real value of the TOW missile in an air-to-air engagement is questionable. It is limited to close-in use and is certainly not considered effective against high performance aircraft. The use of the TOW missile could be considered as a back-up to the 20/30-mm gun in this air-to-air role. This also will provide a somewhat limited multi-capable system which will not degrade the primary anti-armor mission and can provide mutually supporting fires in self-defense air-to-air engagements.

The STINGER requires a relatively small stand-off distance, and can be very effective against high performance aircraft, as well as, helicopters. Instead of placing the STINGER on the attack helicopter, which lowers the numbers of anti-tank missiles, we should fix them to the Scout observation helicopter. This will provide the helicopter attack team mutual supporting fires with a mix of weapons that will increase the probability of success. Mix is one of the factors in considering a viable anti-aircraft network and massing these weapons in one team is the only possible way for them to survive.

Consider the following scenario of an attack helicopter team on the modern battlefield against a highly mobile armor force. A hypothetical attack team might consist of seven AH-1S attack helicopters and three OH-58 observation helicopters. The AH-1S are equipped with eight TOW missiles and the 20-mm gun with the Level 5 fire control system and the OH-58s are equipped with four STINGER missiles. How would such a team be employed?

When intelligence reports verify the enemy's movement and axis of advance along a high speed avenue of approach, the attack teams select attack positions along the enemy's route of march and plan to attack the armor column in unison. The Scout helicopters proceed to the avenue of approach to find the enemy and verify his intentions. Having found the column, the Scouts notify the

attack helicopters that twenty-five enemy tanks are proceeding to their attack positions and be prepared to engage as planned. The Scouts then proceed to overwatch locations to provide support as needed. This support may include artillery, reinforcements, etc.

As the enemy tanks arrive in the kill zone, the attack helicopters engage their predetermined targets. Surprise was achieved with seven simultaneous kills, including the lead and rear tanks. At this point the enemy begins firing machineguns on the horizon to keep the helicopters down, the anti-aircraft guns join the recon by fire.

One attack helicopter to the rear of the formation begins to fire his 20-mm gun as an area weapon. This causes the tank crews to stop firing and button-up, additionally one of the two ZSU-23 anti-aircraft guns is damaged by a high-explosive armor piercing round, rendering it inoperative. As the second ZSU-23 shifts to engage the attack helicopter, the helicopter's (RWR) Radar Warning Receiver alerts the pilot. The pilot activates the chaff dispensers and radar jammers, this causes the ZSU-23 to pause to interrogate the targets. Simultaneously, the attack helicopter begins to use evasive maneuvers just as a team member strikes the ZSU-23 with a TOW missile.

The attack team continues to fire TOWs at the enemy tanks, with each missile finding its mark. The Scout helicopters spot two HIND attack helicopters heading to the

battle, the Scouts maneuver behind the two enemy helicopters and fire STINGER missiles which destroy the aircraft. The Scouts begin to receive fire from a HIND helicopter they overlooked, fortunately a AH-1S engages the HIND with his 20-mm air-to-air capable gun. The HIND is badly hit, leaves the area and calls for assistance. In the vicinity are four MIG-21s which divert from their mission to assist. As they attempt to engage the slow moving evading helicopters, the Scouts fire STINGER missiles which destroys all four high performance aircraft. Meanwhile, the AH-1S attack helicopters finish off the remaining enemy tanks, and head back to base. Enroute, the earlier wounded HIND lays in ambush, as the lead AH-1S passes his position, the HIND engages with gunfire. The AH-1S evades and returns fire with the 20-mm gun. A following AH-1S fires a TOW missile and while unmolested, tracks it directly to the HIND, destroying the last enemy threat.

This scenario may be optimistic, but the fact remains that proper planning, Aircraft Survivability Equipment (ASE) and air-to-air weapons provided the capability to carryout this anti-armor mission. Without this hardware the attack team would possibly have been destroyed or at least required to run for their lives. The ability to stay and fight on the battlefield is the basis for all successful operations, whether in the air or on the ground.

Consider the escort capability of the attack team configured as previously described. The escort team would be able to provide a large helicopter assault force with area fires, anti-armor fires and air-to-air self-defense fires. An air assault with large numbers of troop carrying helicopters has an inherent vulnerability to anti-aircraft and aerial attack, both can be negated with proper NOE techniques and air-to-air hardware.

The systems to be tested in September 1978 reflect those systems which can be fielded immediately. The 20-mm gun can provide the close-in air-to-air support, the STINGER missile is ideal for longer ranges and high performance aircraft, and the TOW missile may be capable of multi-role employment. The 20-mm and the TOW missile are being updated to the 30-mm and the HELLFIRE missile, respectively. The STINGER has evolved from the REDEYE missile and at present is the state of art. Whatever the outcome of the tests, the requirements spelled out in the Letter of Agreement will require a family of weapons. A family, in the sense, where the shortcomings of one system will be overcome by another. Such tests will not, however, solve the problems we face with the long-term defense of helicopters from the aerial threat. These problems areas are the subject of our final chapter.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

The substantial gains in helicopter design and air assault tactics by the Soviets have brought them to an equal, if not a greater capability than the U.S. Army. This is very disturbing, particularly in view of the great numbers of the HIND helicopters being produced and fielded. Additionally, the U.S. Army has been quick to point out a deficiency in the Soviet forces by the apparent lack of doctrine and aircraft for close air support. A realistic appraisal reveals that the HIND can be considered capable of this critical role in addition to the obvious air assault and anti-armor role. This Soviet helicopter is a magnificent combat aircraft, and has the capability which requires three different U.S. aircraft to accomplish the very same missions. The Letter of Agreement for the air-to-air acknowledges the threat of the Soviet HIND combat helicopter, but fails to emphasize the total impact of this aircraft on U.S. helicopter doctrine and the U.S. Army's view of the Main Battle Area (MBA). This lack of understanding and concern of this potential threat by a few in the user community will continue to breed the apathy seen for an effective air-to-air weapon. Because of this, a stronger need for the air-to-air

capability should be considered and stated as an outgrowth of a realistic appraisal of the aerial threat.

Another area that should receive some attention is the current development and testing. The testing data should reinforce the use of all three candidate systems, rather than eliminating one or more of the weapons. There are those who would argue that it is best to develop a new system rather than use the weapons available. These advocates fail to realize the large amount of time needed to accomplish this feat. A much better approach is the one which has been suggested, that is, field a system immediately from the hardware now available, and continue development on hardware that will replace the present systems. This will be more cost-effective than starting a new system from inception and will provide an immediate antedote to the Soviet helicopter threat. By selecting this approach to the air-to-air system, a greater opportunity exists for the development of a family of air-to-air weapons which are capable of neutralizing a wide variety of aerial threats. The limited testing which has been accomplished on the three candidate weapons systems has revealed that with minor modifications all three systems can perform in the air-to-air role. Obviously, each system has some shortcomings but when tailored and augmented with one another in an attack team, their overlapping capabilities will provide effective aerial

self-defense. Currently, no system provides the total answer to the entire spectrum of defense, overlapping the existing systems is the only approach. The testing to be accomplished in September 1978 should first, isolate the modifications required to field the systems and second, establish utilization priorities on individual weapons systems based on their effectiveness. This information passed on to the force development experts, will allow the tailoring of these systems into the attack team as a family of weapons.

The last area of reconsideration is reflected in the earlier discussion of the team concept. The Scout helicopter is a valuable member of the attack team, and it may be too valuable to allow it to remain passive on the battlefield. Recent inquiries and examinations into the need for an Armed Scout Helicopter (ASH) have met with mixed reaction. Again, the development of an ASH from inception is expensive and time consuming. For future needs this development may be necessary, however, for now and the mid-1980s, the OH-58 Scout helicopter can suffice with proper modifications and responsible tactical utilization. In the past the OH-58 has been used for administration flights and carrying VIPs. Elimination of these two missions and the emphasis on the Scout as a combat multiplier for the attack team is the only realistic approach to the immediate problem. Air-to-air weapons must be considered for the OH-58 Scout helicopter,

and the STINGER missile is the best candidate available.

Future requirements for air-to-air hardware for helicopters will place a heavy reliance on dual capability or multi-role employment of the weapon. Fielding of the three candidate weapons as air-to-air capable systems will lay the foundation to expand the development for replacement systems. This development is, of course, in the 30-mm chain gun and the HELLFIRE missile, both of which will provide multi-capabilities to the attack team. Now is the time, at the mid-point of development, that modifications can and must be made to insure an air-to-air capability for both weapons systems.

The requirements for the future air-to-air weapons will be reflective of the current requirements and limitations discussed earlier. The gun system for flexible close-in engagements, a missile with the "Launch and Leave" capability for longer ranges. Both systems will provide mutual air-to-air support within the attack system. The HELLFIRE missile may be capable of engaging high performance aircraft within accepted probabilities, to eliminate the need for a single role missile for that mission. Ideally, the single missile capable of anti-armor, anti-aircraft and air-to-air would be most desirable. This missile when added to the 30-mm chain gun, which is capable of effective area fires, high explosive anti-tank fires and air-to-air fires, would provide a single Advanced Attack Helicopter

with the necessary defensive tools to accomplish its offensive mission on the battlefield. Such a missile would eliminate a total reliance on the air-to-air Scout for survival. The future air-to-air hardware must make maximum use of dual or multi-purpose systems to overcome the limitations of aircraft loads and the degradation of helicopter anti-armor capabilities.

SUMMARY

The capability of the helicopter to fight outnumbered and win will ultimately be determined by its ability to remain on the battlefield. The current view of the attack helicopter from the armor school at Fort Knox, reveals a commitment to the anti-armor role and the maneuver unit concept. The flaw in this doctrine is the assumption that sufficient Air Defense and Air Force assets will be available to silence the various aerial threats. Because of conflicting priorities, sufficient assets will not be available and significant numbers of the attack helicopter force will not return in successive days if the threat is not eliminated. In view of this prospect, maximum effort and ingenuity must be given to the fielding of effective aerial self-defense weapons. This new capability will require an appraisal of the attack helicopter's roles and missions with respect to the ever changing art of war.

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