THUNDERCHOPPER

HELICOPTER OPERATIONS HANDBOOK

Apple II

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For Apple II computers
Program Number AP2-TC1

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Foreword

Welcome to the world of helicopters! To those of you familiar with this world, it's no secret that this is the most dynamic and flexible aeronautical environment. To those enthralled with helicopters because of exposure through M*A*S*H, Blue Thunder, Airwolf or James Bond (all of which portray helicopters in a flamboyant manner), my goal is to provide an interesting and challenging "step beyond."

When one considers strategy and tactics we must recognize that these terms mean ideas or concepts that are formalized and implemented by authority. Strategy and tactics are limited only by human imagination and the aerodynamic limitations of the machine. The intelligent unification of these limitations results in successful tactics and strategy. Ignoring either results in failure.

Your procurement of ThunderChopper is indicative of your interest in helicopters. My obligation is to present a clear, interesting and informative review of the use of helicopters so that you have the background to meet the challenge of ThunderChopper. In trying to meet that obligation, I have decided against the normal approach — repeating that which has already been documented in the library. Instead, I have opted for an approach based upon my own personal experiences and my own flying assignments. In that way I hope to keep you awake; I hope to minimize the turmoil of challenges from those with different experience than mine; and I hope to provide some basic understanding of a segment of aviation understood by a few and badly misunderstood by many. I hope that I will meet these goals. If not, I am sure that I will hear from you. Thank you, and good luck with ThunderChopper.

Colonel John B. Rosenow, USAF (Ret.)
President, ActionSoft Corp.
September 1, 1987

Introduction

Helicopters are perhaps the most versatile flying machines man has invented. They have the capability to fly and land in tight areas inaccessible to fixed-wing aircraft. They are much more maneuverable, with the capability to fly backwards, hover, and rotate in a standing position. It is these outstanding flight characteristics that have made them so valuable in a number of varied situations including rescue, combat, troop transport, and reconnaisance.

ThunderChopper puts you in the pilot's seat of an enhanced Hughes 530 MG Defender helicopter equipped with sophisticated electronic flight and weapon systems (see Figure 1). It is armed with four types of weapons and has advanced defense systems including Forward-Looking Infrared, CO_2 laser radar, and zoom television. True three-dimensional high-speed graphics provide superb realism and action in day, dusk, and night flight modes. Detailed scenarios at different skill levels offer a wide variety of challenges in the areas of flight, rescue, combat, and troop escort.

For an automatic introduction to ThunderChopper, select the demonstration mode (press [0], then [RETURN]) from the main menu. This will demonstrate many of the program's features and graphic displays. Press [ESC] at any time to exit from the demo and return to the main menu. We recommend that you watch the demo and read the first few sections of this manual to familiarize yourself with the capabilities of ThunderChopper, then select Flight Training from the main menu when you are ready to take off into the world of helicopters. Good flight and happy landings!

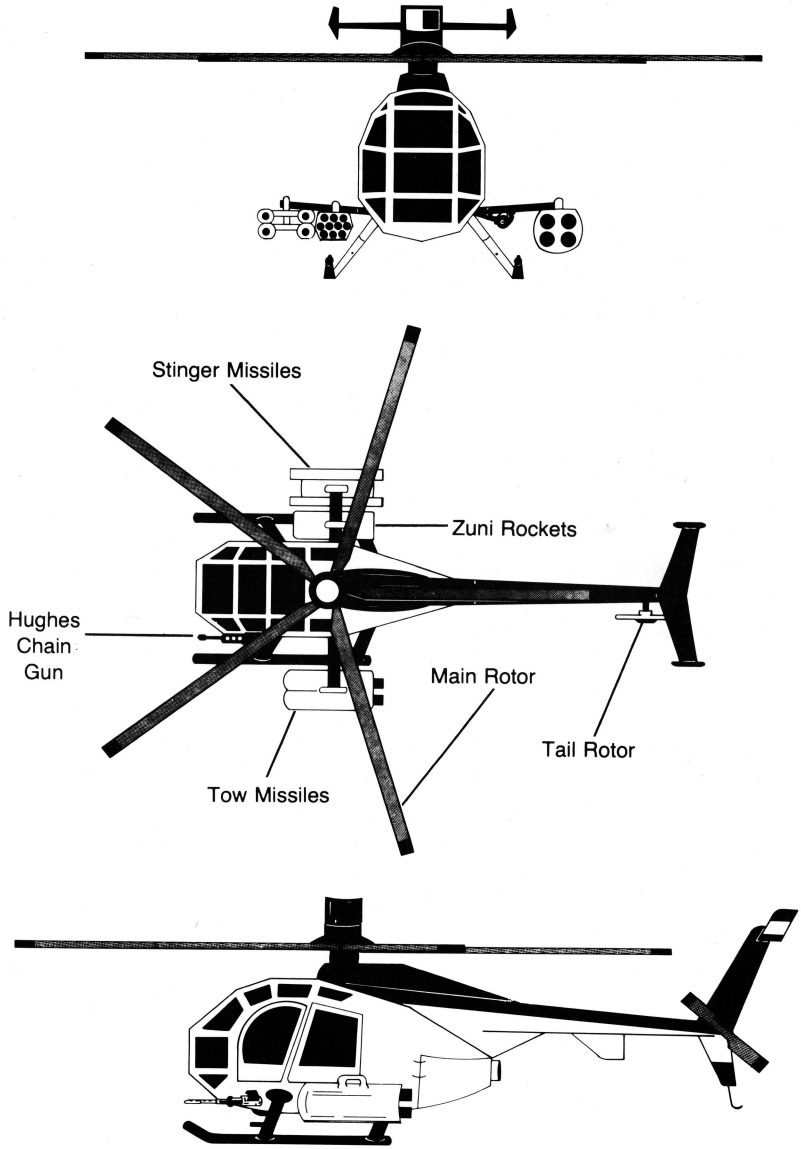


Figure 1. ThunderChopper

Running the Program

The following equipment is required:

1. Apple II, II plus, IIe, IIc, or IIgs computer.
2. At least 64K of RAM.
3. At least one 5.25" Apple floppy disk drive.
4. Color or monochrome monitor.

The following equipment is optional:

5. One joystick.

Boot the ThunderChopper disk as you would boot a normal system master disk. The program will load automatically and the startup menu will appear on the screen.

Keyboard and Joystick Controls

All aircraft functions may be controlled from the keyboard. Most essential flight controls are more easily controlled with a joystick.

Flight Controls

Helicopter flight is controlled by adjusting the cyclic, collective, and tail rotor controls (see Figure 2).

Cyclic control adjusts the pitch and bank of the main rotor blades. Tilting the cyclic to the left or right causes the helicopter to turn left or right. Tilting the cyclic forward increases velocity, and tilting the cyclic backward decreases it.

Collective control adjusts the angle of attack of the main rotor blades. Increasing collective generally causes the helicopter to increase velocity and climb to a higher altitude before stabilizing. Decreasing collective causes the helicopter to descend.

Tail rotor controls adjust tail rotor pitch/thrust. The tail rotor is used to compensate for the torque generated by the rotation of the main rotor blades. It can also be used to turn the helicopter in either direction. For a detailed description of helicopter flight characteristics, please refer to the **Overview of Helicopter Flight Characteristics** section of this manual.

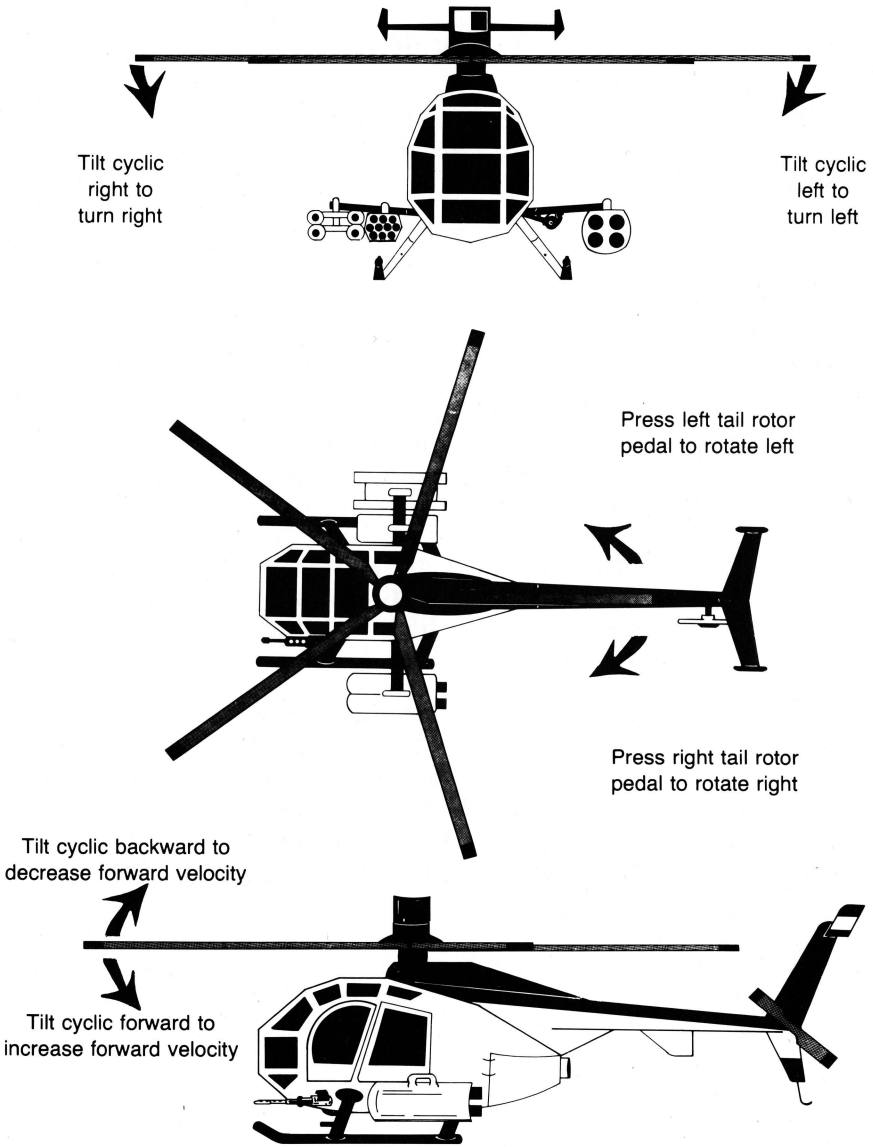


Figure 2. Helicopter Flight Control Surfaces

Control Layout

Figure 3 shows the keyboard and joystick control layout.

Engine Control

[TAB] or [Q]	Engine on/off

Cyclic Control

NOTE: All flight control keys are clustered around the [G] key.

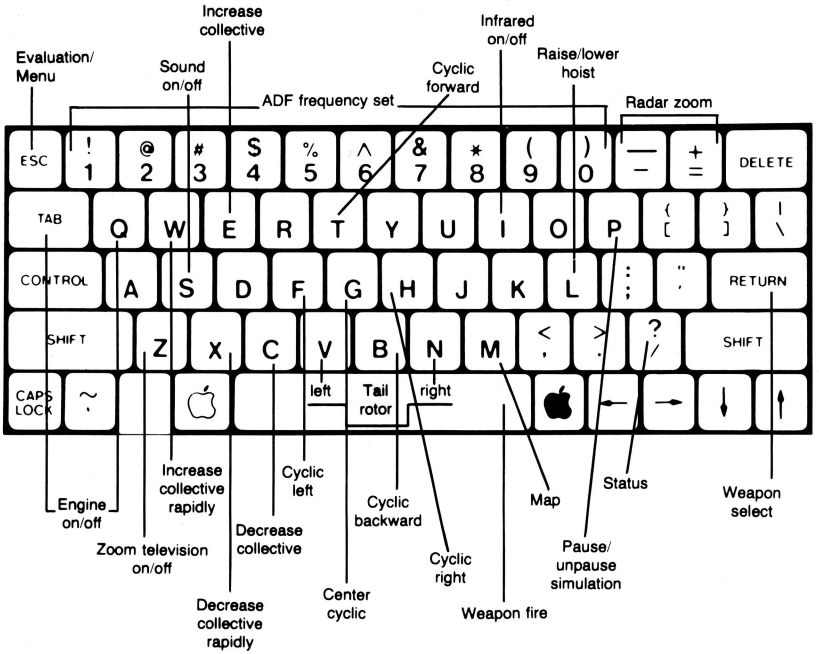
[T]	Cyclic pitch forward
[B]	Cyclic pitch backward
[F]	Cyclic bank left
[H]	Cyclic bank right
[G]	Center cyclic

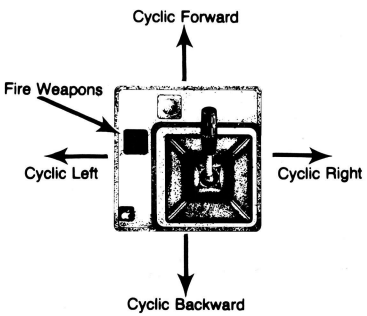
Cyclic control is also available on the joystick. Forward movement pitches the main rotor forward and backward movement pitches the rotor back. Left movement causes left bank and right movement causes right bank.

Collective Control

[E]	Increase collective
[W]	Increase collective rapidly
[C]	Decrease collective
[X]	Decrease collective rapidly

Collective control is also available on the joystick. Hold down the right button and move the stick forward to increase or backward to decrease the rotor blade angle of attack.





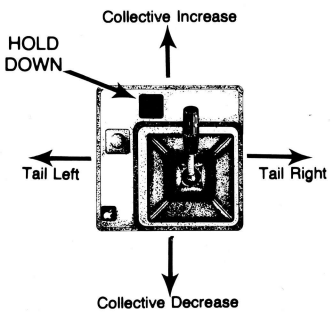


Figure 3. ThunderChopper Controls

Tail Rotor Control

[V]	Tail rotor left
[N]	Tail rotor right

Tail rotor control is also available on the joystick. Hold down the right button and move the stick left or right to turn left or right.

Weapon Control

[RETURN]	Select next weapon
[SPACEBAR]	Fire currently selected weapon

Weapon firing is also available on the joystick. Hold down the left button to fire the currently selected weapon.

Radar Zoom Control

[+]	Increase zoom factor
[-]	Decrease zoom factor

NOTE: Apple II and II+ users may use [*] instead of [+].

Miscellaneous Controls

[I]	Forward-looking-infrared on/off
[Z]	Zoom television on/off
[0] to [9]	Enter ADF frequency
[L]	Lower/raise the hoist
[P]	Simulation pause/resume
[S]	Sound on/off
[O]	Clear text from computer screen

Menu and Display Selection

[M]	Map display
[?]	Status display
[ESC]	Evaluation menus

Overview of Helicopter Flight Characteristics

Helicopter Flight Controls

Three basic flight controls are used in a helicopter equipped with a tail rotor; cyclic control, collective pitch control, and tail rotor pedals.

Cyclic control is operated by the right hand. This control is used to tilt the rotating wing or rotor disc forward, rearward, and sideways. Adjustments to the rotating wing are made simply by exerting pressure on the cyclic control in the desired direction. Tilting the cyclic forward (increasing cyclic) pitches the helicopter's nose down, increases forward velocity, and at lower speeds also increases altitude due to translational lift. Pushing the cyclic very far forward causes a power dive in which the aircraft gains speed and loses altitude very rapidly. Tilting the cyclic backward (decreasing cyclic) pitches the nose up and decreases forward velocity. If you decrease cyclic enough to pitch the nose up above the horizon line, the helicopter will start to fly backwards. The helicopter can be put into a constant left or right turn by tilting the cyclic to the left or right.

Collective pitch is operated by the left hand. This control is moved vertically to increase or decrease the pitch of the rotating wing or disc, enabling the helicopter to climb or descend. (Think of the disc as being a propeller as well as a wing; collective pitch control allows you to increase or decrease the "bite" of the main rotor blades.) Forward airspeed is increased by combining an increase in collective pitch with an increase in cyclic (tilting the disk forward by cyclic control). Reducing collective pitch and applying rearward pressure on the cyclic control decreases airspeed.

Tail rotor pedals, sometimes referred to as anti-torque pedals, are used to counteract the effects of torque. Torque is the force which tends to rotate the fuselage in the direction opposite to that in which the rotor blades are being driven by the engine. Since the blades are being driven in a counterclockwise direction, the nose of the helicopter wants to rotate in a clockwise direction at the same RPM. The tail rotor allows you to control and compensate for this force by applying left pedal. Tail rotor pedals can be used to turn the nose in either direction as required without banking the main rotor. In true helicopter flight the tail rotor must be adjusted constantly to compensate for changes in the collective and cyclic. ThunderChopper, however, makes tail rotor adjustments for you automatically in order to simplify aircraft control. You must still balance your collective and cyclic control in order to maintain steady flight.

The Flight Sequence

With the engine running and rotor RPM at 100%, the pilot raises the collective pitch control to increase the lift of the rotor disc. As the helicopter leaves the ground the pilot applies left tail rotor pedal pressure to control nose movement, and applies slight aft (rearward) pressure on the cyclic control to prevent the helicopter from moving forward. The helicopter is now in a hover. The helicopter can be taxied in a hover simply by applying pressure on the cyclic control in the desired direction.

Hovering over one spot is a key advantage of helicopter flight. This is the least efficient method of operating, however, since it requires great amounts of power and utilizes large quantities of fuel. Moving the helicopter forward at a speed of at least 15 miles per hour permits the helicopter to achieve *translational lift*. Air flowing over the rotor disc at this speed permits flight and climb performance with less power than that required to hover. Movement from the hover, or *ground cushion*, to trans-

lational lift is the most critical phase of the takeoff; during this transition the helicopter is airborne solely due to the lift of its blades.

Every helicopter model has a most effective climb speed. Once this speed is obtained, the pilot climbs at this speed to the desired altitude. When the pilot reaches cruise altitude, he reduces collective pitch to a desired torque setting and applies slight forward pressure on the cyclic in order to obtain cruise airspeed. The tail rotor pedals would neutralize at this point and the tail rotor would "trim" to a cruise setting which nullifies torque effect. Turns while in flight are made by exerting pressure on the cyclic control in the desired direction. No tail rotor pressure is used at all.

When executing an approach to a landing site, the pilot establishes an approach speed with reduced collective and slight back pressure on the cyclic. Approach speed is recommended by the helicopter builder. Airspeed is not critical during an approach; what is critical is that the pilot establish an approach *closure rate* or ground speed in order to reach the site just above the ground (10 feet or so) as the helicopter leaves translational lift and just prior to establishing a ground cushion. This transition from translational lift to the ground cushion is the most critical phase of a landing approach. Usually the pilot comes to a hover prior to touching down. If the pilot attempts to establish a hover at too great an altitude and his airspeed goes below 10-15 miles per hour, it's possible for the helicopter to descend rapidly toward the ground in its own rotor wash/turbulence. This condition is known as *power settling*. Striking the ground at this high rate of speed can cause structural damage to the helicopter.

Approach angle varies with the type of approach. Normal approaches to a hover are made at approximately a 45-degree angle to the ground.

ThunderChopper Variables

In advanced helicopters such as that simulated in ThunderChopper, power is regulated by an electronic fuel control. This allows the pilot to operate the collective pitch without worrying about the availability of adequate power. In order to ensure that enough power is always available, ThunderChopper maintains 100% rotor RPM as long as the engine is running.

In addition, most advanced helicopters have an Automatic Flight Control System (AFCS) which simplifies tail rotor control. This system is always in operation on ThunderChopper, making the helicopter easier to fly.

Flight Systems

Figure 4 shows the lower section of the main cockpit. All of your flight-related gauges and instruments are located here.

Engine Gauges

Engine-specific gauges are clustered on the left side of the cockpit panel. They include the RPM gauge, rotor gauge, and fuel gauge.

RPM Gauge

This gauge will generally read about 300 revolutions per minute once the engine has warmed up. It should stay at or near this level during normal flight. If it falls much below this level, there is a problem with the engine and flight should be terminated as quickly as possible.

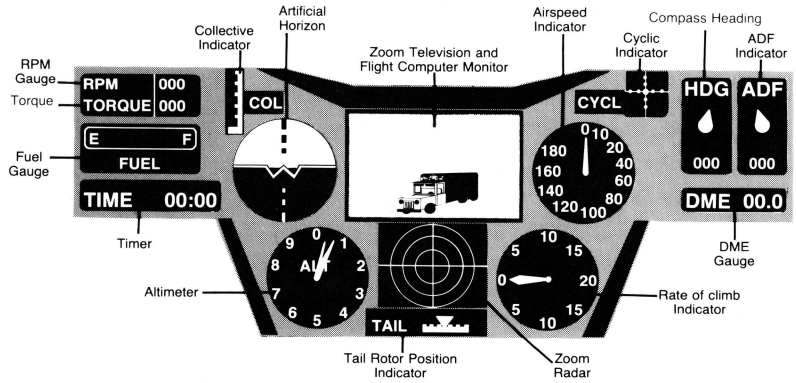


Figure 4. ThunderChopper Cockpit Panel

Torque Gauge

This gauge indicates the level of the collective as a percentage. In order to achieve takeoff it is necessary to bring the collective up to about 60%. A normal reading for the torque gauge during regular flight is between 65% and 75%. When increased performance is required, it is not unusual to increase collective above 90%.

Fuel Gauge

The fuel gauge indicates the amount of fuel available. If you run low on fuel, you must return to a base as quickly as possible.

Flight Gauges and Instruments

Flight instruments include an artificial horizon, airspeed indicator, altimeter, and rate of climb indicator. Additional gauges are included to indicate the position of the collective, cyclic, and tail rotor.

Artificial Horizon

This instrument indicates the pitch and bank of the real horizon. It is usually easier (and more useful) to look out the window to determine your aircraft's attitude, but in very inclement weather and on very dark nights this gauge is essential.

Airspeed Indicator

This gauge displays ground speed in knots. This is the speed at which you are moving relative to the ground, and does *not* indicate your vertical velocity.

Altimeter

This gauge indicates altitude above sea level in feet. The big hand displays altitude in hundreds of feet while the little hand displays altitude in thousands of feet.

Rate of Climb Indicator

This gauge displays the rate at which the aircraft is ascending or descending in hundreds of feet per minute. An ascent or descent of more than 500 feet per minute is potentially unsafe in normal flight.

Navigational Aids

Navigational aids are located on the right side of the cockpit. They include a compass, ADF gauge, and DME gauge.

Compass

This compass consists of a needle and a digital readout. The needle always points in the direction the aircraft is pointing. North is straight up. A digital display below the needle indicates the aircraft's heading in degrees, reading clockwise from a due north heading of zero degrees.

ADF Gauge

ADF stands for Automatic Direction Finder. When you tune in a specific ADF broadcaster, your ADF gauge will point directly at that broadcaster. ADF broadcasters are usually found on downed pilots and near helipads. The broadcaster is directly in front of you when the needle points straight up. A three-digit display below the needle indicates the current ADF frequency.

DME Gauge

DME stands for Distance Measuring Equipment. The DME gauge indicates distance to the current ADF broadcaster in miles, expressed to a precision of one-tenth of a mile.

Flight Computer

The flight computer serves a variety of purposes. It provides valuable information (such as ADF frequencies), offers useful suggestions, and provides danger warnings. You should pay close attention to the flight computer's scrolling messages.

In addition to messages, the flight computer doubles as the zoom television display. See **Zoom Television** in the **Weapon and Defense Systems** section of this manual.

Zoom Radar Display

Zoom radar is essential for identifying friendly and enemy objects. The radar is capable of picking up any object that contains a significant amount of metal. Enemy vehicles are displayed in white, friendly vehicles and downed pilots in black, and missiles in red. Zoom factor is controlled by pressing the [+] and [-] keys. Pressing the [+] key increases zoom factor and pressing the [-] key decreases zoom factor. The zoom factor (1X, 2X, 4X, or 8X) is displayed in the lower left corner of the radar screen.

NOTE: Apple II and II+ owners may use [*] instead of [+] to increase zoom factor.

Weapon and Defense Systems

ThunderChopper is heavily armed with four different types of weapons: Tube-launched Optically-tracked Wire-guided (abbreviated TOW) missiles, Stinger (STNG) missiles, Zuni rockets, and a Hughes Chain Gun (HCG). It is also equipped with sophisticated electronic warning, detection, and guidance systems. In order to make maximum use of each weapon and to survive the variety of threats you will face, it's important to understand the capabilities of each weapon and defense system.

Weapon Selection

Available weapons are listed at the top of the screen display (see Figure 5). The number of missiles and rockets available is indicated by missile icons. The number of rounds for the Hughes Chain Gun is indicated by dots (each one representing 25 rounds) to the right of the HCG label. The currently selected weapon is highlighted in white. Press the [RETURN] key to cycle through and select from among the different weapon systems.

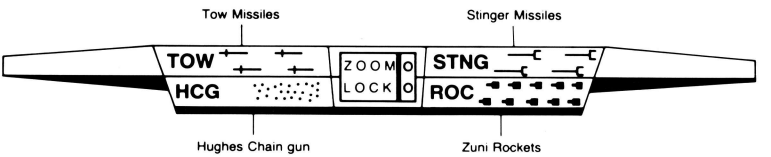


Figure 5. Weapons Display Panel

It is important to choose the appropriate weapon for each task. The following table describes the capabilities and uses of each weapon:

Weapon	Mass in Kilos	Applicable Targets	Guidance
TOW missile	13.1	tank, large vehicle	optically-guided
Stinger missile	15.8	heat-emitting	heat-seeking
Hughes Chain Gun	0.1	small, unarmored	none
Zuni rocket	12.0	large, stationary	none

Weapon Firing

The currently selected weapon is fired by pressing the [SPACE-BAR], or by holding down the joystick firebutton and pressing the stick to the left. You will see missiles, rockets, and/or chain gun tracer bullets in the out-the-window display. Stinger missiles, Zuni rockets, and chain gun bullets are out of your control once they've been fired. You must guide TOW missiles to the target.

TOW missiles are optically-guided and controlled by the pilot. You are responsible for guiding the missile to its target by maintaining a tracking box on the target. If you can successfully guide the missile, the target usually will be destroyed. If a TOW missile loses track of its target it will continue to fly in its current direction.

Zoom Television

The zoom television display occupies the same area of the screen as the flight computer. Both may be in use at the same time. When the zoom television detects that you have locked onto an object, it superimposes an enlarged image of that object over the flight computer display. Zoom television is useful for making a final positive identification of an enemy target before firing your weapons.

Zoom television is enabled by pressing the [Z] key. Press the [Z] key again to disable it.

Infrared Display

The infrared display is most useful at night to identify heat-emitting objects such as motorized vehicles. It can be very difficult to detect dark objects against a dark background at night. When the infrared display is activated, heat-emitting objects appear as bright white against a red background.

The infrared display is enabled by pressing the [I] key. Press the [I] key again to return to standard view.

Heads Up Display (HUD)

The Heads Up Display consists of tracking boxes, a gunsight, and a locked box (see Figure 6). When the flight computer detects an enemy object, it will track that object with a tracking box. After the flight computer has identified a potential target, it is your responsibility to lock onto that target by maneuvering your gunsight into the tracking box. Once you have done this, the flight computer will lock onto the target and the tracking box will turn into a locked box. It's much more

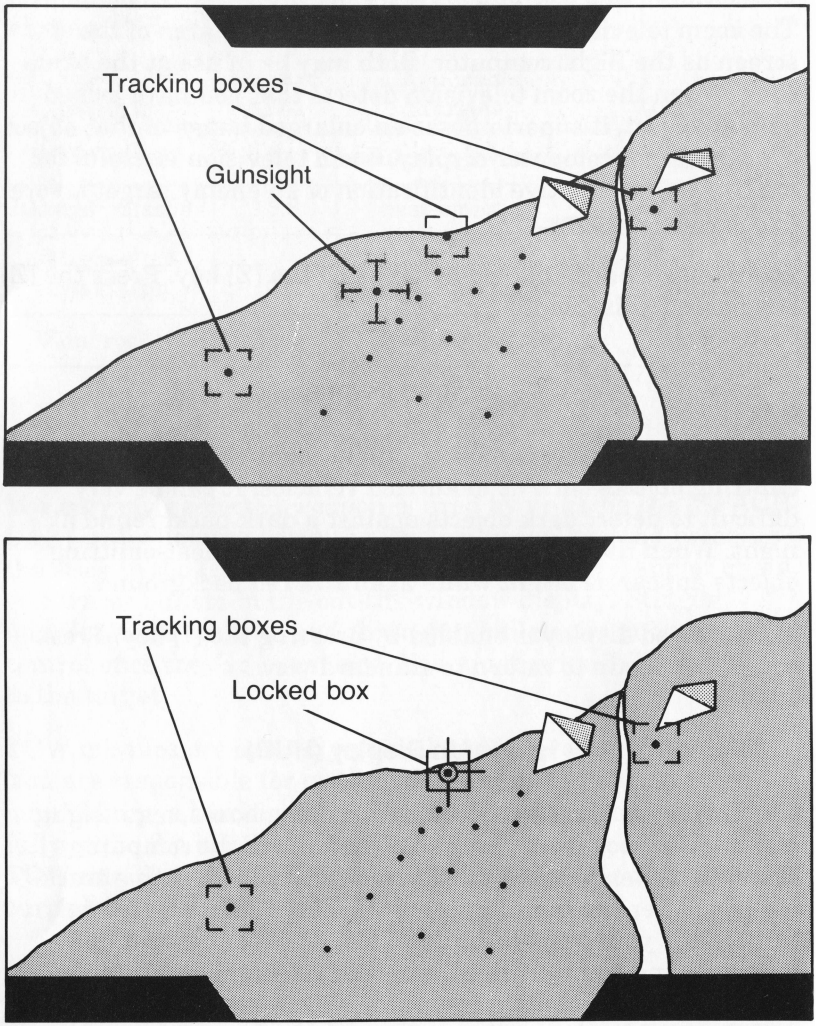


Figure 6. Heads Up Display

likely that a guided missile will be able to find and destroy an enemy target once you have locked onto it.

Zoom television is also activated by the locking system. Once you have enabled zoom television by pressing the [Z] key, any object that you lock onto will be shown on the zoom television display. This is a valuable means of positive target identification.

The floating gunsight also serves as a cyclic position indicator. When it is in the center of the screen and even with the horizon, that indicates that the cyclic is in a neutral position and the helicopter is in a steady hover. If the gunsight is below the horizon line, then the rotor is tilted forward; if it's above the horizon, the rotor is tilted backward.

Map Display

The map display is accessed by pressing [M] from the cockpit display (see Figure 7). It shows a detailed terrain map and the major objects in your area. The map display rotates automatically so that the direction in which you are facing is always at the top of the screen. A pointer in the top left corner of the display always points due north to indicate your present heading direction.

Moving

You can examine any area of the map display simply by pointing to that section of the map. Use the cursor keys to move the map cursor left, right, up, or down, and then press the [SPACE BAR] to redraw the map. In conjunction with the zoom feature (see below), this function is useful for examining in detail the terrain of a faraway section of the territory you are exploring.

Zoom Control

Nine different zoom factors are available on the map display, ranging from a super wide-angle view showing the whole territory to a tight closeup view that allows close inspection of small objects.

The zoom factor is controlled by pressing the [+] and [-] keys. Pressing the [+] key increases zoom factor, and pressing the [-] key decreases zoom factor. Pressing the [SHIFT] and [+] keys simultaneously zooms all the way in, while pressing [SHIFT] and [-] zooms all the way out. Apple II and II+ users may use [*] instead of [+] to increase zoom factor.

Press the [RETURN] key to exit the map display and return to cockpit display.

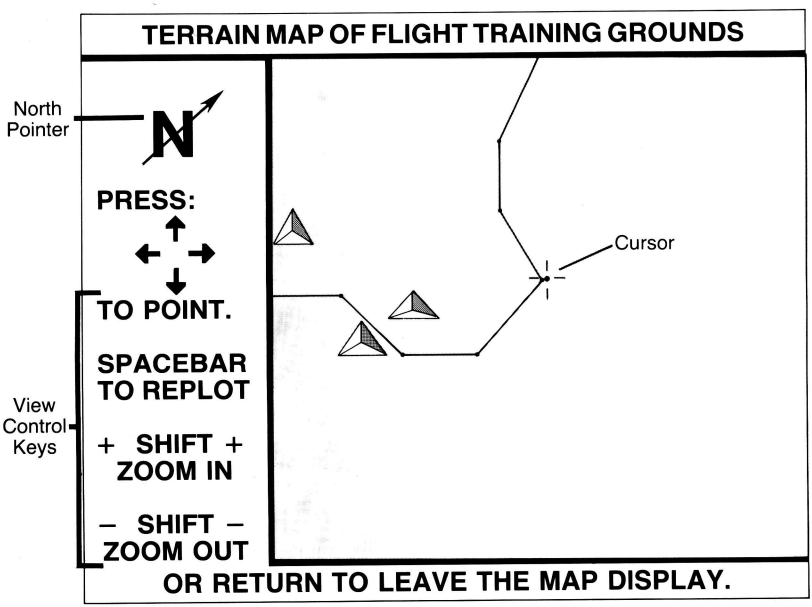


Figure 7. Map Display

Status Display

The status display is accessed by pressing the [?] key from the cockpit display (see Figure 8). It provides valuable information on the status of all important aircraft systems. There are twelve different systems, organized into three separate categories: navigational aids, weapon systems, and engine systems. A fully-functioning system is listed as OK. If damaged, it is listed as HIT, and if it has been destroyed or exhausted, it is indicated as being OUT. A damaged system is highlighted in red on the helicopter top view display. Damaged systems can be repaired at any base.

Press [RETURN] to exit the status display.

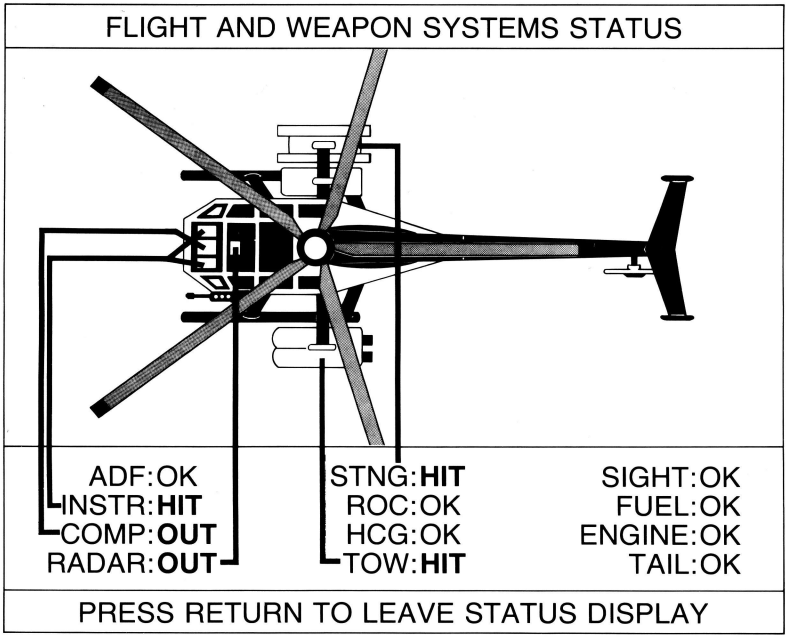


Figure 8. Status Display

Choosing a Mission

There are five separate missions in Thunderchopper, numbered 1 through 5. Each challenges the pilot in a different aspect of helicopter flight. It's a good idea to fly the missions in sequential order since the more advanced missions will require talents and abilities acquired in the easier ones.

The first three missions are entitled Flight Training, Rescue Alert, and Combat Alert. These missions emphasize flight, rescue, and combat techniques respectively. They allow you to concentrate on one aspect of ThunderChopper training without having to be concerned about all other factors. The last two scenarios, Armed Escort and Rescue at Sea, combine some or all of the abilities and techniques learned in the first three scenarios.

Mission Selection

Press the number key for the mission you'd like to select. The name of the mission you choose will be highlighted in black. You may also use the arrow keys to select a mission.

Skill Levels

ThunderChopper missions may be performed at any one of three different skill levels; Pilot, Commander, or Instructor. Select a skill level by pressing the [P], [C] or [I] key respectively.

Pilot is the lowest skill level. You should select this skill level the first few times you fly a mission. When you satisfactorily complete a mission at the Pilot level, you will be promoted to Commander, and then to Instructor. If you perform particularly badly as a Commander or Instructor, you might be de-

moted. Higher skill levels increase the realism and difficulty of the mission. In the more advanced scenarios you will encounter more dangerous and numerous enemy threats.

Getting Your Orders

Once you have selected a mission and a skill level, press [RETURN] to get your orders. You will receive a short briefing describing your mission goals and the areas of performance in which you will be evaluated. After you've read and understood these orders, press [RETURN] to accept them and fly your mission.

ThunderChopper Missions

Flight Training

Purpose

Flight Training should be your first mission. The goal of this mission is to familiarize yourself with flying the helicopter in an environment free of any distractions (enemy fire, etc.). The flight computer will provide valuable feedback during your flight, such as whether you are flying too high or too erratically. It will also maintain information on how well you fly the course for your end-of-mission evaluation.

If this is your first time flying the training course, select the Pilot skill level. You will have an easier time flying and landing the helicopter at this skill level. Training takes place during the day. Your primary objective is to follow the black course line, landing on ground and building helipads as instructed. You will receive frequent orders and feedback from the flight computer. (See Figure 9.)

Getting Airborne

Press the [TAB] or [Q] key to start the engine. Wait a few seconds while the engine warms up and the RPM's climb to around 300. To take off, increase collective (hold down the joystick button while pushing the stick forward) to about 65%. You will begin to climb and then stabilize at a constant altitude. Apply some forward cyclic (push the joystick forward with button released) to get some forward speed. You should also climb a bit and stabilize at a higher altitude. If you push the cyclic too far forward you will begin to go into a dive, so be careful to not apply too much pressure. Once you've achieved level and steady flight, you can concentrate on flying the

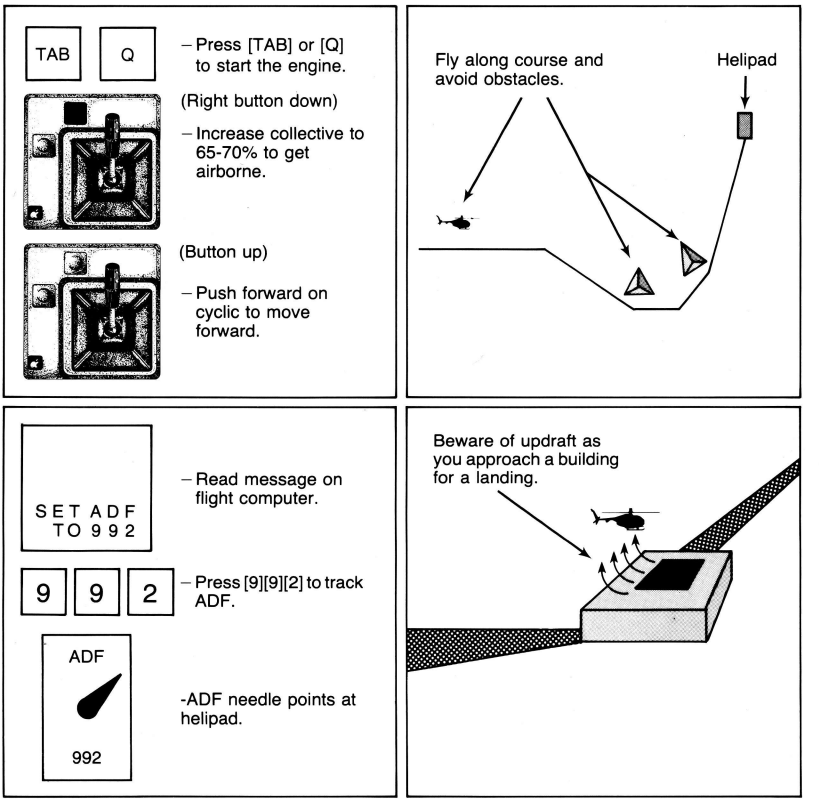


Figure 9. Flight Training

course. Note that in order to increase speed you must increase collective as well as cyclic pitch, or else you will gain altitude. In general, keep in mind that you must adjust both collective and cyclic in order to change your altitude or velocity.

Flying the Course

Remember that your objective is to fly along the black course line. That is the main factor in your evaluation. If you follow the course, you will not lose track of the helipads and you will steer clear of the mountains. If you should lose track of the course you can still track your ADF needle to get to the next helipad, and refer to the DME gauge to see how far away you are. You can also refer to the map display (press [M]) if you lose your bearings. You may find it useful to frequently refer to the map display while flying the course to get a better idea of what lies ahead.

Coming in For a Landing

As you approach a gray helipad or building, decrease altitude and velocity simultaneously by decreasing collective and pulling back on the cyclic. You should try to land with very little vertical or forward velocity, to avoid damaging the aircraft. When approaching a building, be aware that you will gain extra lift as you fly over the edge.

When you have successfully landed on a helipad, the ADF frequency of your next landing site will be displayed. Set your ADF gauge to the new frequency, and continue flying the course.

Evaluation

Your flight will be evaluated after you've completed the course by landing on all the helipads. The evaluation will consider such factors as course tracking, landing accuracy, maintenance

of level and steady flight, and elapsed time. If you do a good job in all of these categories you will be promoted to the next skill level. If you do a particularly bad job, you may be demoted to the next lower level for further training. When you are promoted to the level of Instructor, you are ready to move on to the Rescue Alert mission.

Suggestions for Flight Training

Pay attention to controlling the helicopter and maintaining level and steady flight rather than to maintaining a high airspeed. It should not be necessary to make any wild turns if you are flying under control. Be particularly careful when coming in for a landing, and watch for the added lift due to updraft as you approach a building.

Rescue Alert

Purpose

Once you've attained a level of flying proficiency by completing the Flight Training scenario, you are ready to train for one of the most important duties a helicopter pilot can perform — the rescuing of downed pilots. You will use all of the flying skills acquired in Flight Training, and will develop the ability to identify downed pilots visually, with navigational aids and by using your map. There are no enemies on this mission, so you can concentrate on sharpening your pilot location and rescue skills. This will prepare you to test your abilities in later dramatic rescue scenarios under fire. (See Figure 10.)

Locating Downed Pilots

Your flight computer will provide you with valuable information to aid in the location of downed pilots. Depending on your skill level, some or all of the downed pilots will have ADF broadcasting equipment. If a pilot is so equipped, your flight computer will tell you which frequency to tune into.

Some pilots may not have ADF broadcasting equipment. If not, you will have to identify them visually and by referring to the map display. The flight computer will provide necessary information. Because of the nearby aircraft wreckage, all pilots can be detected by radar. Radar is useful to get a general idea of the location of faraway pilots.

All pilots are equipped with emergency flares which they will periodically launch if they notice your helicopter nearby. Scanning the horizon will help you to identify pilots by their emergency flares. If a pilot is on the far side of a mountain he won't be able to see you and won't launch a flare, so be sure to scout behind mountains as well.

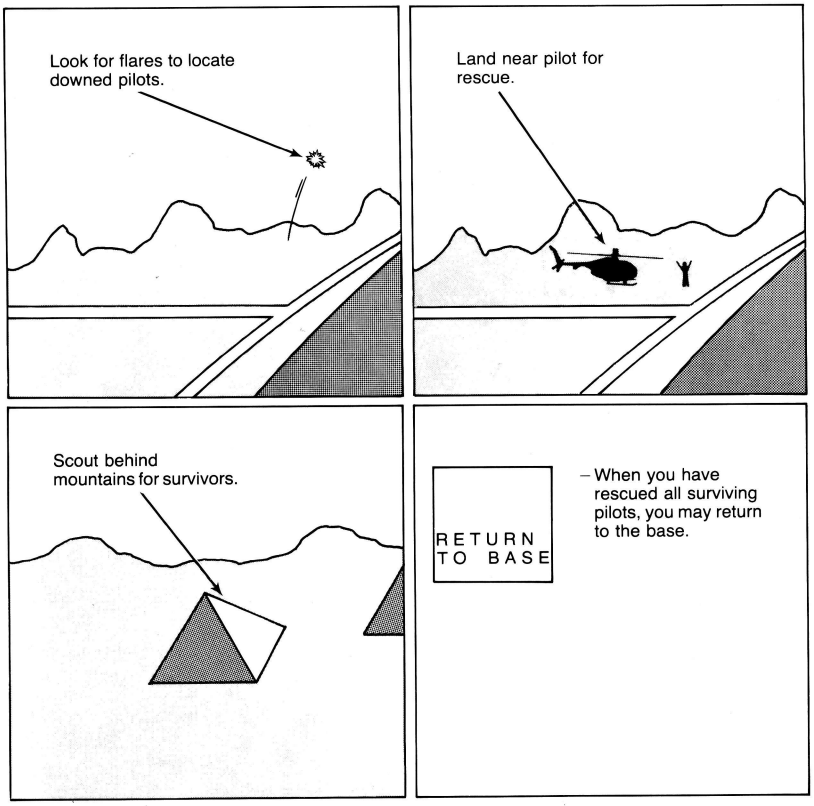


Figure 10. Rescue Alert

When flying at night, you may find it useful to use the infrared display to locate downed pilots. The heat from their wreckage can be detected by the infrared display. Press the [I] key to activate or deactivate the infrared display.

Rescuing Downed Pilots

When you locate a pilot you should have no difficulty in flying to him and landing nearby. If you land close enough, your zoom television will identify him as a friendly pilot and he will board the helicopter. You will then be ready to rescue the next pilot.

When you've rescued all downed pilots, your flight computer will notify you that you can return to base.

Evaluation

You must rescue all pilots in order to complete this mission. Your evaluation will be based on how quickly you are able to complete the mission. If you are able to quickly locate and rescue all downed pilots, you will be promoted to the next skill level. Pilots are more difficult to locate at the higher skill levels.

Suggestions for Rescue Alert

It's best to follow the directions from your flight computer. This will help you to minimize your flying time and quickly complete the mission. You may, however, rescue pilots in any order if you wish.

Pilots equipped with ADF broadcasters are the easiest to locate. At higher skill levels, some pilots will not have ADF broadcasters and you will have to locate them visually. If you can't find a pilot, fly in a circle and scan the horizon for flares. (It is not a good idea to merely spin in a hover as that is hard

on the helicopter.) Remember, if you don't see any flares, the pilot may be behind a mountain where he can't see you. Be sure to scout behind all mountains.

Combat Alert

Purpose

Once you've mastered flight and rescue techniques, you are ready for combat. On this mission you are confronted with a number of enemy threats which you must locate, identify, and destroy. You must become adept at selecting and controlling your weapons and at using sophisticated electronic weapons systems for the location, identification, and destruction of enemy targets. (See Figure 11.)

Since this is your first combat mission, enemy targets will return fire rarely depending on your skill level.

Locating Enemy Targets

The flight computer is a valuable aid in locating enemy targets. It will identify them for you on the television monitor, and control the tracking and locking system. When an enemy target nears firing range, it is identified by a tracking box.

Enemy targets will appear on the zoom television if you position the gunsight over the target in the visual window. Zoom television is useful for positively identifying a target before firing on it. Radar can be used to locate most enemy targets; they will show up as red blips.

Refer to the map display (press [M]) for geographical information, in particular to determine the distance and direction to enemy targets identified by the flight computer.

Destroying Enemy Targets

Once you have positively identified an enemy target, you are ready to destroy it. For small targets such as light trucks, your guns will be sufficient. Position the gunsight over the truck

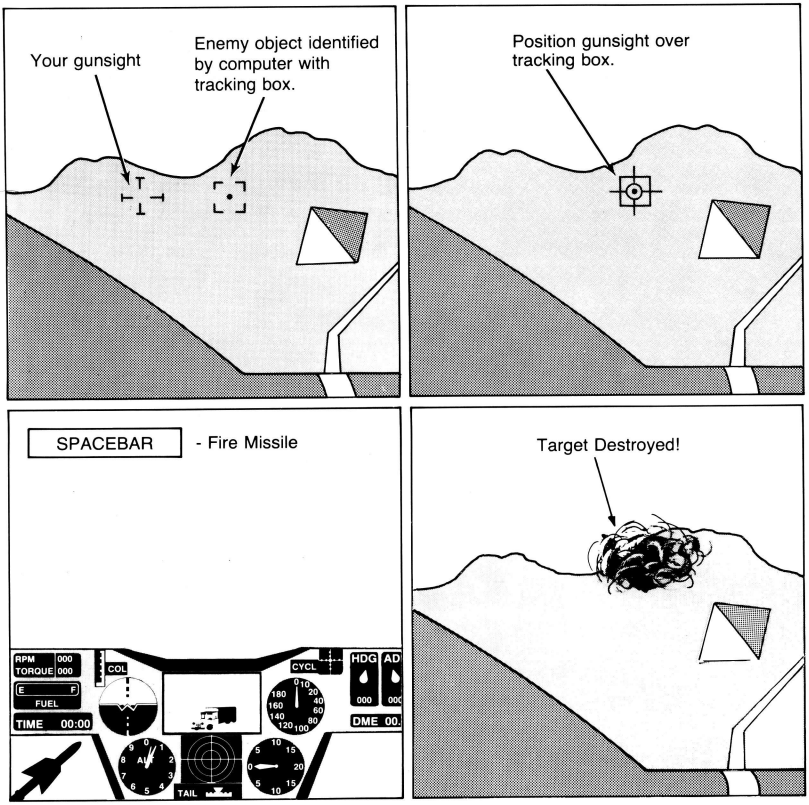


Figure 11. Combat Alert

and fire at will. For larger targets such as bridges and warehouses, you will want to use missiles or rockets. Zuni rockets are non-tracking, so they continue to fly in the direction in which they were fired. They are most useful for destroying large stationary objects. Stinger missiles are heat-seeking, so they should be used to destroy targets that emit heat such as boats, planes, and heavy trucks. TOW missiles are laser guided and must be controlled by the pilot after they are fired. They are controlled by maintaining the lock on the target. If this lock is broken, the missile will continue in the direction in which it was last moving. As long as this lock is maintained, the TOW missile will continue to the object and destroy it. TOW missiles are very useful for destroying tanks, but can be used for any target with which you can maintain visual contact.

Evaluation

You will be evaluated on how many enemy targets you destroy, how efficiently you use your ammunition, and the amount of damage your helicopter sustains.

Other Information

Return to base to refuel, rearm, and repair your aircraft. The ADF frequency of your base is 573.

Suggestions for Combat Alert

Pay attention to the flight computer, and be sure to use the proper weapon for the enemy target you wish to destroy. Guns will not be effective in destroying a bridge, and using several Zuni rockets to destroy a truck is a waste of ammunition.

Check your status display (press [?]) frequently to make sure there are no problems with your aircraft. If you find a problem, return to base immediately.

Armed Escort

Briefing

Your mission is to escort a small number of battle-weary troops and light vehicles back to safety through enemy territory. The only way out is through a valley guarded by numerous enemy guerilla fighters armed with automatic weapons and light artillery. You must locate and eliminate the guerillas to prevent them from killing your troops. (See Figure 12.)

The road along the valley bottom is the only route to safety. You are escorting slow-moving vehicles, so you must fly slowly. You are in radio contact with the ground forces, and if you get too far ahead of them you will be notified by computer.

Spotting the Enemy

Some of the techniques used in Combat Alert for locating enemy targets will be useful here. The flight computer will not be able to help you locate any targets until after they have fired on you, but zoom radar can be used to locate those that are metallic enough to be detected. The best means of locating and identifying enemy targets is by the flash from their weapons fire.

Evaluation

Your evaluation depends primarily upon the number of your troops that make it to safety.

Suggestions for Armed Escort

Remember that your primary responsibility is to look after the safety of the troops you are escorting. Be careful not to get too

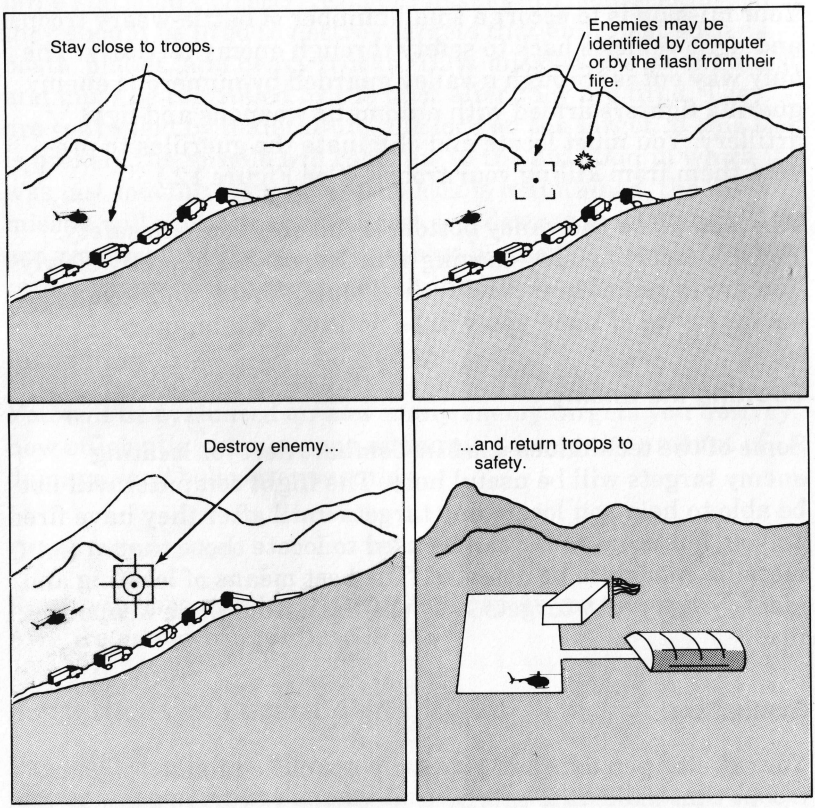


Figure 12. Armed Escort

far away from them, even though it sometimes may be necessary to scout ahead for enemies. Pay close attention to radar and constantly monitor the terrain for signs of enemy gunfire. Watch for your flight computer to occasionally relay radio information concerning guerilla location.

Don't fire your weapons indiscriminately, since you are unable to rearm during the mission. Remember also that there is no way to repair the aircraft until you reach the safety of the base; if your helicopter becomes too severely damaged, all troops may be lost.

Rescue at Sea

Briefing

A major sea battle is winding down and you are charged with finding and rescuing the survivors from your base on a destroyer. Search near the wreckage for survivors and lower the hoist to bring them to safety. But beware of remaining enemy ships, and be prepared for battle! (See Figure 13.)

Your objective on this mission is to rescue the survivors, not to engage the enemy. If you are fired upon you may return fire in defense, but it is not a good idea to needlessly engage battleships from a helicopter.

Locating and Rescuing Survivors

Most surviving pilots are equipped with ADF broadcasters, so this is the best means of locating them. The flight computer will pass on ADF frequencies as they become available. Those pilots not equipped with ADF broadcasters must be located visually. Search for their flares and scan the waters with your zoom television. Radar may be useful in identifying large pieces of wreckage which are frequently surrounded by survivors.

When you locate a surviving pilot or crewman, you must hover low over the water and rescue him by dropping your hoist. Press the [L] key to drop the hoist. Once the crewman has secured himself to the hoist, press the [L] key again to raise it. Do not fly with the hoist down; this increases wind drag, and the hoist may become damaged.

Returning to Base

You are based on a destroyer in a relatively safe area away from the battle. The destroyer is equipped with an ADF broad-

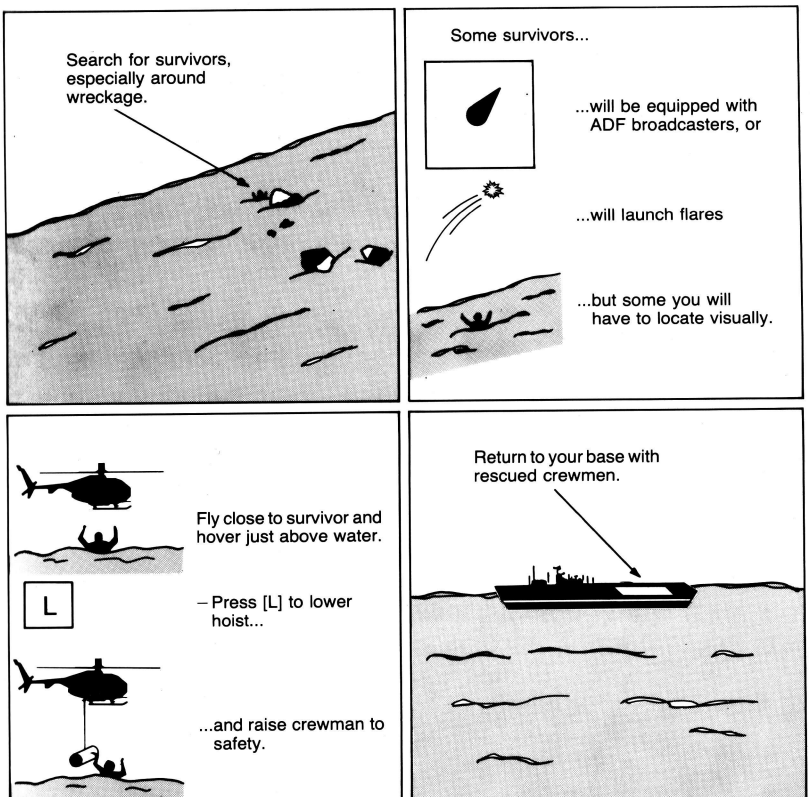


Figure 13. Rescue at Sea

caster operating at a frequency of 279. After picking up three or four survivors you should probably return to base, so that they may receive medical attention and so you don't get shot down with several people on board.

If your aircraft becomes damaged you will want to return to the base for repairs. You are fully refueled and re-armed every time you return to base.

Evaluation

You are evaluated solely on the number of survivors you safely return to base. The mission will have been a complete success if you rescue and return all survivors.

Suggestions for Rescue at Sea

Remember that this is a rescue mission, not a combat mission. Although you carry a sophisticated arsenal of weapons, it is dangerous to engage the enemy ships. Avoid them if possible, but rescue the surviving crewmen as necessary. Return to base often, since it would be foolish to get shot down during a rescue attempt with several rescued survivors on board.

Check the status display (press [?]) often to see if there is a problem with any of your systems. Beware of fuel leaks, and return to base immediately if one occurs. Pay attention to the flight computer for rescue information.

Evaluation

At the end of each mission you will be evaluated on your success in completing that mission. You should concentrate on achieving the goals outlined in your pre-mission briefing. In the first three scenarios you are evaluated on how well you are able to demonstrate your abilities in the areas of flight, rescue, and combat. In the more advanced scenarios, you are evaluated on how well you complete the mission objectives.

If you perform well on a mission you may be promoted to the next rank (or skill level). You should continue to fly each mission until you achieve the level of Instructor. Once you attain that rank you are ready to move on to the next mission. If you perform particularly badly on a mission, you may be demoted to a lower level.

Appendix I - A Personal History of Helicopters by Colonal John B. Rosenow, USAF (Ret)

Many professional aviators begin their story by stating that flying was a boyhood dream. I had no such dream. I was introduced to flying by my late father, a private pilot and the owner of a Navion. However, the final encouragement to fly as an Air Force Officer came from Colonel Frederick Sanders, USAF (Ret.), then assigned as Professor of Air Science at DePauw University in Greencastle, Indiana. After receiving my commission, I entered flight training at Marana Air Base near Tucson, Arizona. I was trained in the T-34 and T-28. My basic training was in the B-25 at Lubbock, Texas.

My introduction to helicopters occurred in the fall of 1955. I was assigned to Edward Gary AFB, San Marcos, Texas, where I learned to fly the Bell H-13. From that day on, helicopters

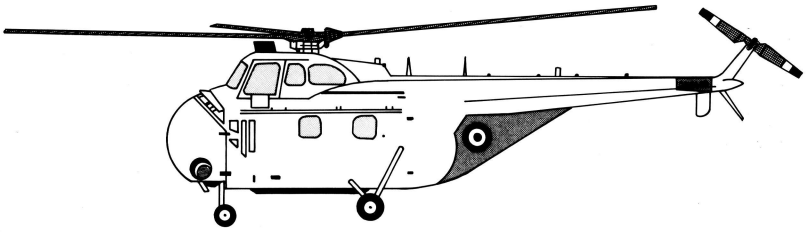


Figure 14. Sikorski H-19 (S-55)

became my "first love." Advanced training was conducted in the Sikorsky H-19, the mainstay of the Air Force Air Rescue Service (see Figure 14). That training took place at both Edward Gary AFB and at Randolph AFB, Texas. Upon completing training, I was assigned to the 83rd Air Rescue Squadron at Spangdahlem Air Base, Germany. Thus my first flying job was one in which the goal was to help save lives. That opportunity did not come to many. I was fortunate enough during a tour of duty in Turkey to be involved in a life saving mission — a feeling that is indescribable.

During the time of my service in Germany, all U.S. military services were operating helicopters. The U.S. Army was heavily involved in airlift/logistics support for their units worldwide. They used not only helicopters, but also fixed-wing transports to meet these obligations. The U.S. Navy and the Marine Corps used helicopters to resupply their ships at sea and to provide airlift for attached Marine units. The safety of their aircrews

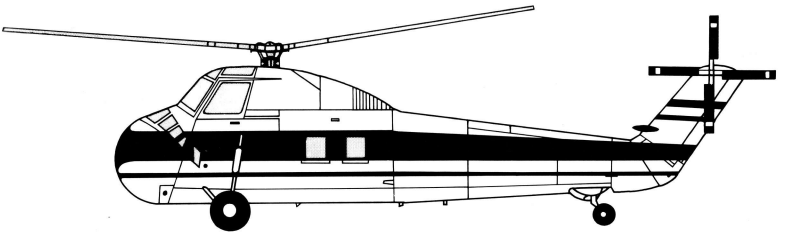


Figure 15. Sikorski H-34 (S-58)

aboard aircraft carriers was supported by helicopters as well. The Army used the H-19 (S-55), the H-34 (S-58), the Piasecki H-21 (known as the "Flying Banana"), and Vertol helicopters (see Figures 15 and 16). While initial versions of the Vertol helicopters were piston powered, they now rely on a totally turbine fleet. The Navy and Marines used the same types of equipment for their operations. It is important to note that the Army, Navy and Marines have maintained a solid, straight line helicopter capability. The Air Force, equipped primarily to provide rescue, fluctuated greatly. The periodic buildup of rescue capability during conflict became inevitable. During my tour in Germany, the Air Force readjusted their rescue capability into what was called "Local Base Rescue." Their assets were placed under control of the local Wing Commander, with coordination through the Air Rescue Coordination Center. Helicopters were allocated primarily to operational wings operating fighter and bomber aircraft.

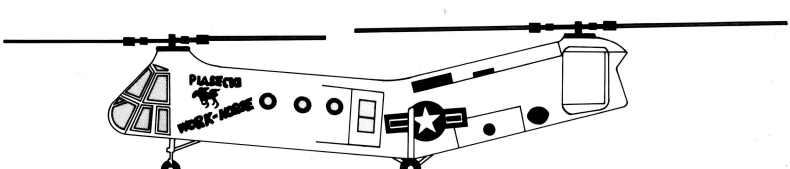


Figure 16. Piasecki H-21 "Flying Banana"

From late 1959 through 1968, my assignments in the Air Force were out of helicopters. I flew as an instructor in C-130 and T-29 (Convair) aircraft. Ironically, my duty in C-130's was to lead to the most demanding helicopter assignment I could ever hope to have. More on that later.

During this time, the United States entered the Vietnam conflict. There was a massive buildup of all forces, and economics led to an important agreement between the Air Force and the Army to consolidate all fixed-wing airlift under the Air Force. During this time frame, the Army formally became the primary user of helicopters. They formed their Air Cavalry units and developed a mobility never before achieved. The backbone of this mobility was the UH-1 — the Huey (see Figure 17). The UH-1 has become one of the most used helicopters in the world. The use of armed helicopters to support assault forces became standard. The "Cobra" entered the

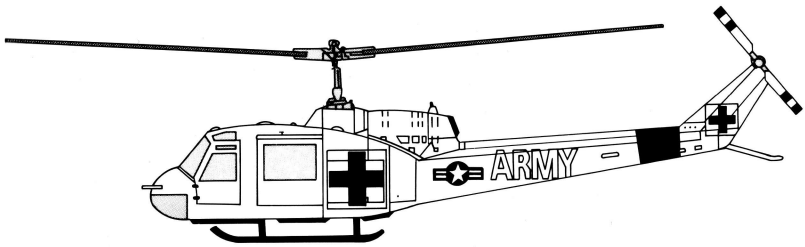


Figure 17. Bell UH-1 "Huey"

inventory (see Figure 18). The air mobile concept was proved in an environment not considered ideal — the jungles of Vietnam.

My tour in Vietnam allowed my reentry into helicopter operations. I served as an Advisor to the 217th Helicopter Squadron, Binh Thuy AB, RVN. While the U.S. Forces were operating the UH-1, the Vietnamese Air Force was operating the older H-34 helicopters. The primary role of the VNAF was resupply and medical evacuation of military and civilians from outlying camps. Following the Tet offensive, the 217th Helicopter Squadron became involved in the "Vietnamization" program by participating with the U.S. Army in combat assault operations. This integration went slowly, with initial problems, but it was a step toward a more effective use of Vietnamese helicopter resources.

The U.S. Air Force operated an extensive rescue and airlift support effort using the CH-3 "Jolly Green Giant" and the HH-

Figure 18. Bell AH-1 "Cobra"

53 "Super Jolly Green Giant" helicopters (see Figures 19 and 20). A special unit dubbed "Pony Express" supported special airlift requirements, including command and control with CH-3E's. The Navy and Marines were active in airlifting supplies to their forces and supporting their flight crews. They used H-3 and H-53 helicopters as well as the "Chinook" (see Figure 21). Overall command and control in the theater was under the Military Assistance Command, Vietnam (MACV). I would be remiss if I did not mention a special group of helicopter pilots and crewmen using UH-1's who comprised "Dustoff." This unique and dedicated group performed heroic airlift of wounded throughout the theater of operations. I was impressed by medical evacuation efforts of the VNAF -- but none could compare with the performance of "Dustoff".

Unknown to me at the time, the Air Force had another helicopter operation in the theater. Ironically, my reassignment from Vietnam was to a small test organization at Point Mugu,

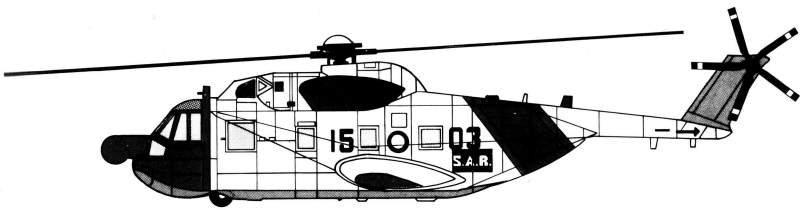


Figure 19. Sikorski CH-3 "Jolly Green Giant"

California. The mission was to flight test Air Force drones. These drones were air launched by specially-equipped C-130 aircraft and were recovered in mid-air by modified CH-3 helicopters.

The drone system was developed through the cooperative efforts of the Teledyne-Ryan Aeronautical Company, Pioneer Parachute Company, and the All American Engineering Company. The Mid-Air Retrieval System (MARS) was developed in order to provide maximum flexibility in the overall drone system. The use of drones for reconnaissance and intelligence required a capability to launch from DC-130's anywhere in the world. Air retrieval was developed in order to recover the drone and its payload over land or sea. Mid-air retrieval provided a drone without damage for re-launch turnaround.

The Air Force modified CH-3E helicopters with a winch and hook and pole assembly which enabled the pilot to "snatch" a

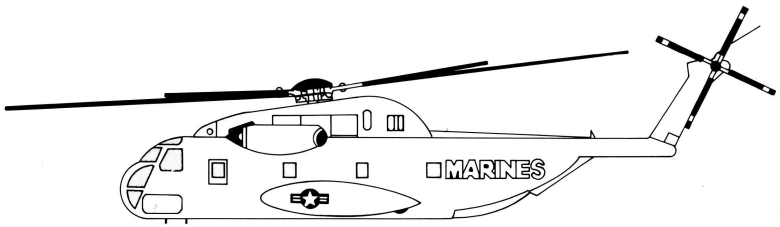


Figure 20. Sikorski HH-53 "Super Jolly Green Giant"

small ringslot parachute that flew about 150 feet above the large recovery parachute. Once engaged, the main chute was released and the drone was carried some 200-300 feet below the helicopter on a load line. Reel-in was then accomplished until the drone was just below the helicopter fuselage in "stow."

My assignment to Pt. Mugu NAS, CA, introduced me to one of the most dynamic programs ever developed. My experience in both C-130's and helicopters gave me the opportunity to fly both the launch and recovery of drones. In fact, on numerous occasions, I had the rare pleasure of launching a drone by DC-130, landing and then going airborne in a CH-3 and "catching" the same drone.

While the initial effort was the launch and control of single drones, Tactical Air Command became involved in a program of multiple launches of Electronic Warfare/Chaff drones. Their DC-130 aircraft were modified to carry and launch up to four

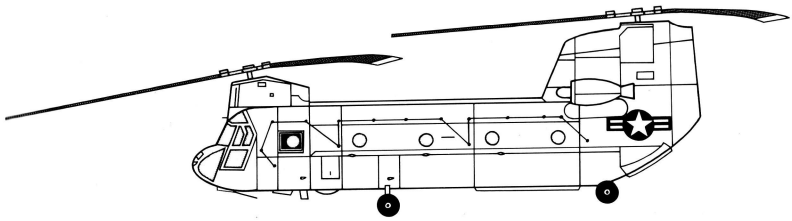


Figure 21. Boeing CH-47 "Chinook"

drones. This program, called Combat Angel, involved a multiple-drone control system enabling the control of up to eight drones from a single DC-130 aircraft. During the initial stages of testing at Pt. Mugu, I was pleased to participate in the first "rapid turnaround" recovery effort which consisted of recovering four drones with the same helicopter through the use of a staging area on San Nicolas Island near Pt. Mugu. The practicability of such an approach was proved, but unfortunately never finalized by TAC.

In a parallel effort by Air Force Systems Command (AFSC), the Air Force developed a more sophisticated, higher-performance and larger drone, Compass Arrow. In an economic move, the Air Force consolidated the development of drone programs at Edwards AFB, CA in June 1970. The 6514th Test Squadron was formed with DC-130 and CD-3 aircraft from both Air Force Logistics Command (AFLC) at Pt. Mugu and Air Force Systems Command, Holloman AFB, New Mexico. My assignment to that unit as a Lt. Colonel and the Operations Officer afforded me the opportunity to continue multiple currency in C-130's and helicopters. It was as the result of a near accident in 1971, while recovering a larger Compass Arrow drone, that we obtained approval to modify an HH-53 helicopter for MARS use. The HH-53 proved to be the answer, due to its larger size and additional power. The flight test of the HH-53 was one of the most interesting tasks in which I became involved. The HH-53 proved invaluable during testing of the Compass Arrow and the deployed operations of the unit at Dugway, Utah, where we operated in density altitudes of over 6000 feet.

My work in the drone problem led to my selection as Commander of the 11th Tactical Drone Squadron, Davis-Monthan AFB, Arizona. The "White Owl" squadron had been assigned the task of testing and operating the Combat Angel Multiple Drone System. The unit had just received CH-3 Helicopters. It was during the first eight months of operations that I became

involved in the training and qualification of TAC aircrews in Mid-Air Retrieval. We deployed to Gila Bend, AZ, for five-day periods for the training. In December 1972, I was assisted in that training by Mr. Tom Gray, All American Engineering Co., a pioneer in these operations. To this day I will always remember the reaction of the new crew members to the dynamics of MARS. They were so shocked by the system, they decided to make "If We Make It Through December" their theme song.

The unit became active in supporting their own operations in March 1973. This self-sufficiency included the deployment of our DC-130's and helicopters at Virginia for overwater operations. Those operations included the mid-air recovery of two drones over water and the docking of those drones on ships at sea. To prepare for this three pilots were carrier qualified with the Navy.

During this same time frame, the Navy qualified limited aircrews for MARS operations in support of target recovery and limited shipboard operations. While at Pt. Mugu NAS, I had the pleasure of training several Israeli pilots in MARS as well.

Over the past several years, the Army has continued their dynamic development of attack helicopters. The Air Force has developed a more flexible rescue capability, with night and low-level operations.

All are familiar with the hostage rescue attempt in Iran. If I was to "second guess" that effort, I would say my experience has proved that "the more you fly 'em, the better they fly." Information in the press indicated that decisions were made not to fly the helicopters — or at least minimize the flying. Helicopters can become hydraulic nightmares due to the many seals necessary in the hydraulic systems. The rapid cooling/heating of these seals and the high RPM operations tend to cause problems. I have found that the more the helicopters

remain on the ground, the more leaks are likely to occur. Seal leaks can cause major problems and can lead to the failure of major hydraulic systems.

One of the limiting factors in helicopter operations is the high rate of fuel consumption in hover operations. In addition, the limited range of these vehicles has hampered their use. This limitation is leading to the development of a concept in which rotors are rotated forward once airborne, thus serving as "propellers."

The first limitation has been overcome to a great degree through mid-air refueling, mainly from KC-130 aircraft. The non-stop deployment of CH-3 helicopters from the CONUS to Paris through mid-air refueling proved their flexibility once the interface of helicopters and fixed-wing aircraft was accomplished.

While this story has addressed military operations primarily, the civilian use of helicopters continues to progress. From the timberlands of Washington State and Oregon to off-shore oil rigs, helicopters of every type continue to provide the flexibility necessary for specific tasks. Their use as medical evacuation vehicles is on the increase. It is unfortunate that the loss of several of these helicopters in bad weather has dampened the value of such a use. Recent accidents with "traffic" copters have caused great concern regarding their value. It must be remembered that while the use of helicopters is limited only by human imagination, a human understanding of their limitations is mandatory for their safe operation. The human element is the primary cause of accidents, not the machine.

As a flight instructor with the University of Illinois, I stress above all else the need for self-discipline in the operation of the helicopter. While many students find my approach demanding, they have all without exception recognized, prior to the completion of training, that without this recognition of man/machine/

discipline interaction, an accident can occur. With proper understanding of the limits of machine and human judgment, an accident need not occur.

About the Author

Colonel John B. "Jack" Rosenow was born in Chicago, Illinois in 1932. He attended Senn and Amundsen High Schools in Chicago before attending DePauw University in Greencastle, Indiana. He graduated from DePauw in June 1954 with a BA and received his commission through ROTC. He entered flight training in 1954 at Marana Air Base, AZ and then completed his training at Reese AFB, TX in September 1955. He attended radar controller school at Tyndall AFB, FL prior to entering helicopter training in Texas. He was assigned to the 83rd Air Rescue Squadron in Germany for four years. He then served in helicopters at Sewart AFB, TN when the H-19's there were phased out. He served as Aide-de-Camp to the Commander of the 839th Air Division at Sewart before becoming an Instructor in the Combat Crew Training school which trained C-130 aircrews for the Air Force. He then served at HQ Tactical Air Command before attending Air Command and Staff College. His early selection for promotion to Major resulted in his obtaining a Regular Air Force Commission. He served as an Advisor to the Vietnamese Air Force at Binh Thuy, RVN, before being assigned to Pt. Mugu NAS, CA for service in the testing of drones and recovery systems. He was operations officer of an Air Force drone test squadron at Edwards AFB, CA and later assumed command of the 11th Tactical Drone Squadron at Davis Monthan AFB, AZ. Following his selection for Colonel, he was transferred to HQ TAC to manage the drone test effort in the DCS/Requirements. He was later instrumental in the consolidation of all Air Force Drone programs under Tactical Air Command. He retired from the Air Force in October 1978 and joined the University of Illinois

Institute of Aviation. At the University he is a flight instructor in single-engine aircraft, multi-engine aircraft, and helicopters. He is also a Course Supervisor and Flight check pilot.

"Colonel Jack" has a Master of Arts Degree in Education from Middle Tennessee State University. He joined ActionSoft as President in July 1986.

He is also active in the "Aviation Ambassador" Program of the Illinois Department of Transportation. He is a single parent of five grown children.