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PREFACE - ABOUT THE GAME

Welcome to the world of interactive simulation, and congratulations on choosing what we think is one of the best and most accurate flight simulators currently available. Good flight simulators have been available for several years, but AV-8B HARRIER ASSAULT extends the concept by asking the player to play two roles. (1) As Commander of the Rapid Deployment Force (RDF) you will run the campaign of Operation Ocean Saber, a UN-authorized invasion of East Timor in Southeast Asia. Tasked with landing US Marines in hostile terrain held by a well-armed and numerically-superior enemy, you'll make strategic and tactical decisions for the force as a whole. (2) As a squadron pilot, you'll fly the AV-8B Harrier jump jet from the flight deck of the USS Tarawa, taking this revolutionary vertical take-off fighter into combat against the armed forces of Indonesia, the nation which seized East Timor in 1975.

AV-8B HARRIER ASSAULT will place you in command of a naval task force consisting amphibious assault ships, an escort of powerfully-armed warships, transport ships, landing craft, eight thousand troops, their vehicles, stores, helicopters, and a squadron of McDonnell Douglas AV-8B Harrier II aircraft. Get the feel of what it's like to be in command of a powerful naval force able to project US military power on distant shores, then feel the thrill of being the pilot of one of the world's most effective close air support aircraft. But remember, if you fail in either role, the prisoners of war being herded behind barbed wire to await the journey home will be wearing US rather than Indonesian uniforms.

If you purchased AV-8B HARRIER ASSAULT expecting it to be a normal flight simulation, and don't want to play the role of task force commander, then don't worry. Using expert systems technology built into the game, your computer will be able to run the campaign, selecting the objectives of the land and sea forces, positioning the ships, and specifying the missions for the AV-8B Harriers, leaving you free to enjoy flying a simulation whose flying characteristics and cockpit layout are closely modelled on those of the real aircraft.

The expert systems also control the actions of the enemy forces, who will respond to your decisions and tactics. This allows you to play the game many times, trying different methods of dealing with a large defending force determined to fight for what it regards as Indonesian territory. It won't be easy - a decade of struggle against the East Timor resistance has honed the combat skills of the Indonesian Army.

CONFIGURING YOUR SYSTEM FOR AV-8B

AV-8B requires a minimum of 2 megabytes of RAM to run. It will run with EMM386.SYS but it will make better use of memory if you do not use it. Included on disk 2 is a bare bones AUTOEXEC.BAT and CONFIG.SYS. To use these rename your existing files to .OLD and replace them with the ones on disk 2.

Installing AV-8B

To install AV-8B, at the A: prompt type INSTALL and follow the onscreen prompts.

Thrustmaster

AV-8B is fully compatible with the thrustmaster range of joystick and throttle controllers.



SECTION

1

INTRODUCTION

INTRODUCTION

AV-8B Harrier Assault is essentially two games in one. The first is an accurate flight simulation of the McDonnell Douglas AV-8B Harrier II vertical/short take-off and landing fighter. In this part of the simulation you'll take the role of an AV-8B pilot. The second is a full-simulation of an amphibious landing operation on a hostile shore by a US Marine Expeditionary Brigade. In this part of the simulation, you'll play the task force commander.

The flight simulation

AV-8B Harrier Assault incorporates an extremely accurate simulation of the AV-8B Harrier. This is based on two sophisticated aerodynamic models. One is designed to provide as true a representation of the aircraft's performance as possible, and is one of the most realistic aircraft simulations ever written for a personal computer. The second model is simpler, and is designed to help the novice player get into the game as quickly as possible, without having to worry about the complexities of the full aircraft model. Players are advised to start with the simpler version, particularly if new to flight-simulation games. Once you've mastered combat flying using this version, switch to the full simulation to experience the nearest thing your PC can offer to the sensation of flying the real aircraft.

As a pilot, you'll fly a series of missions in support of the task force. Before each mission, you will be provided with a pre-flight briefing on your targets and the likely level of enemy defences you'll encounter. The Nav (navigation) system of your aircraft will be automatically programmed with the co-ordinates of these targets, and a suitable weapon load will be installed. You fly your mission and, if you survive, can return to the Tarawa. A post-flight debriefing session will report the success or failure of your mission, results which will have an effect on the overall state of play. The Marines on shore are relying on you for support. If you fail, they too may fail in their mission.

The strategic simulation

As AH commander of the task force, you have two objectives. Before the outbreak of hostilities, you will have to devise an overall plan for the amphibious landing and the subsequent ground battle with the enemy's forces. You'll decide where to move the ships under your command, and on which beaches to send the Marines under your command storming ashore. Which targets will you "soften up" by air attack? Which are to be assaulted by helicopter-borne special forces? Deciding won't be easy.

Once a plan has been devised, you can start the simulation. The computer will act as your staff, passing commands to the units tasked with carrying out the individual parts of your plan. They, in turn, will try to achieve what you have asked. To provide a challenging and realistic campaign, we have simulated the entire combat zone and every vehicle in it, both friendly and hostile. Every unit, vehicle and weapon participating in the battle is controlled by the simulation software. This will react to your actions and inputs, creating a simulated battle in which friendly and hostile forces respond in a realistic manner both to each other and to your commands.

Multi-layer expert systems are used to control the enemy forces, creating a life-like response in real time. Moving realistically, these enemy units will fight your forces, providing you with a strategic and tactical challenge. As the campaign progresses, you'll have to "fine tune" the battle plan, responding to the movements of the enemy, and the successes or failures of your own forces. You may have to send out new units or alter the orders of units in the field in order to reinforce a critical part of the battlefield, exploit a breakthrough, or stop a retreat.

To win the game, you must play both roles to some extent. You can play (or replay) the game acting predominantly as a pilot or as overall commander, or attempt to perform both roles to an equal degree. If you've played flight simulations in the past, you will probably start by concentrating on the pilot's role. If you're a war games player, you may opt to concentrate on being commander for your first campaign. Eventually, you'll want to face the challenge of handling both functions.

To play predominately as a pilot, all you need do, as commander, is to select and initiate a battle plan from the Tarawa's Tactical Amphibious

Warfare Data System (TAWADS) computer. AV-8B missions will be generated automatically, according to the pre-set plan and also as required to meet changing state of battle. On its own, TAWADS is not a particularly effective commander; it can only respond in a limited manner to changing tactical circumstances. If you don't take any decisions in the role of commander, but leave it all to TAWADS, you will have to be a very successful pilot to win the campaign!

To play predominately as the task force commander, you must create and initiate your own battle plan, then monitor the progress of the conflict and respond tactically by creating more plans. AV-8B missions will be flown automatically for you by the computer, but be aware that the computer is much less effective at knocking out targets than all you will be after a few hours of play. The Marines are outnumbered and out-gunned on the ground by a factor of 4 to 1, so winning air superiority - and flying strike missions is very important. To win by playing purely as commander, you will have to be a strategic and tactical genius, and be prepared to accept high casualties on the ground as your Marines fight without the massive level of air superiority and air support which US ground forces have always had in the wars of the last half-century.

The information you need to play the game is contained in the following sections of the manual:

Campaign Overview

The crisis in East Timor, and why the United Nations has authorized the US forces to intervene in this long-running conflict.

Quick Start

A walk-through of two typical AV-8B missions. This section will get you into the air and flying combat missions as quickly as possible. It will also familiarise you with the general features of the simulation.

AV-8B Pilot's Manual

This describes the AV-8B, its on-board electronic systems and its weapons. You'll learn how to obtain pre-flight briefings and post-flight debriefings; how to select, weapons, how to control and fly the aircraft; and how to use the aircraft's electronic systems and sensors to navigate

mid how to use the aircraft's electronic systems and sensors to navigate mid attack air and ground targets.

Ships and men of the Task Force

A description of the USS Tarawa, and the other warships, assault ships and support ships taking part in the operation. This section also describes the Marine forces under your command, explaining how they are organized into battalions, companies and platoons, and gives short descriptions of their weaponry.

On board Tarawa

How to move around the flagship of your Marine Expeditionary Brigade. The location and purpose of each of the vessel's compartments in described, plus short-cuts which will take you rapidly from one major location to another. You'll also learn how to jump from the Tarawa into the cockpit of any AV-8B currently flying a combat mission, and how to switch to spectacular outside views of the aircraft.

Flight Training

Aboard Tarawa is a flight simulator which you can use to practice the flying skills needed in the game, and allows these to be practiced. For players new to the world of flight simulation, a Primary Training section explains the basics of how to fly an aircraft.

Task Force Commander's Manual

The entire process of creating a battle plan is described, along with instructions on how to use the Tactical Amphibious Warfare Data System (TAWADS), the sophisticated command and control system which you'll use to create this plan and to pass orders to the forces under your command.

Intelligence Brief

Descriptions of the aircraft and weapons you're up against, and estimates of the numbers available to the enemy. The intelligence

experts also report how the AV-8B performed during combat missions in the Gulf and how the Harrier and Sea Harrier performed in the Falklands - this information should help you visualize V/STOL jet combat and the problems you'll face.

Historical Background

The information in this section is not needed to play the game, but it is provided as background reading. The first section describes how the AV-8/Harrier family of V/STOL jets was developed; the second charts the history of East Timor since that territory was seized by Indonesia in 1975.

Controlling the simulation

AV-8B Harrier Assault is designed to be played using a pointing device - either a joystick or a mouse. You can fly the simulation from the keyboard, but you'll need a mouse or joystick for full control of TAWADS.

Mouse & Joystick

In the rest of the manual, you'll find reference to "clicking", "double-clicking", and "dragging". If you've already used a mouse or joystick, you're probably familiar with these terms already. If not, here's what they mean.

Single Click - depress and release pointer button immediately. A

Double Click - depress and release pointer button twice in quick succession.

Drag - depress button, move pointer and then release button.

Menus

You will also meet several menus. In many cases these will have a title line, appearing as a box at the top of the menu. In other cases, their purpose will be self-explanatory when you look at the menu contents. A red check mark is shown against options which are currently selected.

Sometimes options will be greyed out, indicating that they are not available under the current circumstances.

Select the option using the up and down arrow keys, then press (space) to change its state. Press (ESC) to close the menu when you're finished. The menus you'll meet below decks in Tarawa can also be operated by the mouse or joystick. Clicking on an option will select or de-select it, and close the menu. If you want to change several options in a menu it's easier to use the keys.

Mouse and joystick control are not available for menus accessed from the AV-8B cockpit - in this case, the mouse or joystick is already being used to control the aircraft, so these menus must be operated via the keyboard.

Waypoints

An essential concept throughout the simulation is the use of waypoints. If you're an experienced war gamer or flight simulator enthusiast, you're probably familiar with waypoints. If not, don't worry - waypoint is just the military jargon for something you've been using for years when giving directions. A waypoint is simply a geographic location at which some sort of action must be taken when you get there.

To see waypoints in action, imagine giving a friend the following instructions:

"Drive south along Main Street, turn left at the first stop light, carry straight on past the school, turn left at the town hall, and the *pizza* joint is on the left, directly opposite the library. Buy six pizzas, then go back up the street, go left at the town hall, then watch for Joe's Computer Store on the right. Wait in the parking lot behind Joe's until the rest of us show up with the beer."

The stop light, school, town hall, library, and Joe's Computer Store are waypoints in a plan which will eventually see six pizzas delivered to a bunch of hungry guys in the parking lot. To fulfil the mission, your friend had to go from one waypoint to another, changing direction or following other instructions ("buy pizzas" or "wait") as he reached each one.

In AV-8B Harrier Assault, you'll use way points to navigate ships and aircraft, and to command the start of different types of military operations. Instead of sending your hypothetical friend to the pizza joint way point to buy pizza, you might be commanding Tarawa to proceed to way point 3, then launch a Harrier to attack Lore then Tutuala. For the Harrier, Lore, Tutuala, and Tarawa will be way points programmed into its Nav system.



SECTION

II

CAMPAIGN

CAMPAIGN OVERVIEW

Five months ago, a hard-line faction in the Indonesian Army seized control of the country while senior members of the Indonesian Government were visiting Japan to sign a long-term agreement covering trade and industrial co-operation between the two nations. Since then, the country has been run by a military junta.

Following the imposition of press and broadcasting censorship, the new rulers moved swiftly to silence all civilian opposition to their regime, imprisoning without trial all major opponents of the junta: Prominent politicians of all parties and trade union leaders, plus those religious leaders, journalists, broadcasters and members of the police and judiciary who spoke out against the coup.

Large-scale pro-democracy demonstrations in the streets of Djakarta and other major cities were ruthlessly suppressed by armed soldiers. Estimates of the number of demonstrators killed by troops have ranged from 300 to over 1,500.

In an attempt create some measure of public support, the new regime has now promised a speedy end to the long-running rebellion in East Timor, a former Portuguese colony which Indonesia invaded and annexed in 1975. Despite repeated United Nations resolutions, Indonesia has always refused to grant independence for what it regards as one of its legitimate provinces. For more than a decade, repeated reports from East Timor have described persistent human right violations of the Timorese people by Indonesia, including mass arrests, detention camps, executions, and the destruction of entire villages.

Recent military communiqués from the junta talk openly of a "final and complete military solution" intended to end the rebellion. From its temporary exile in Japan, the legitimate Government of Indonesia has asked the United Nations to intervene to prevent the possibility of large-scale atrocities in the region.

The only military force in the area with the capability to intervene is an amphibious force of US Marines. Currently at sea and scheduled to begin Exercise Ocean Guardian, the small force is not a full-strength

Marine Expeditionary Brigade, but has only a single vessel equipped with the AV-8B V/STOL jet fighter. Although some replacement aircraft are present on the decks of the other assault ships in the fleet, this force must make do with less than half the number of aircraft which would normally be assigned to a landing operation, and only a single flight deck from which to operate them - the assault ship USS Tarawa.

As this small force cruises off the southern coast of East Timor, the United Nations discusses the crisis. Following an all-night debate, the UN passes a resolution authorising the United States to intervene in East Timor.

As the US President signs the orders which will translate the wishes of the UN into action, in the Timor Sea it's a few hours until dawn. Aboard Tarawa, technicians give the vessel's AV-8B Harrier II fighters a final check over, while armorers fit fuses to bombs and missiles. In Tarawa and the other vessels of the task force, live ammunition is readied, and landing craft are prepared for action. Aboard the escorting warships, guns and missile launchers are loaded with live rounds. Ocean Guardian is about to become Operation Ocean Saber. . .

Priority: Flash (transmitted 16.12 EST)

Classification: Top Secret

From: National Security Advisor

To: Commanding Officer, Operation Ocean Saber

In pursuance of last night's United Nations resolution authorising the use of force to protect the people of East Timor, the President of the United States issued the following orders at 16.00 Eastern Standard Time today:

1. Using the vessels, aircraft, and personnel currently under your command, you are ordered to use such force as might be

required to suppress and terminate all operations in the territory of East Timor by the Indonesian armed forces, and to prevent the arrival of further Indonesian forces.

2. In a personal phone call to the President, the Secretary-General of the United Nations has made it clear that he views the situation as urgent. You will not await reinforcements. Operations against the Indonesian forces on East Timor are to commence immediately using those units currently under your command.
3. For reasons which will be made clear to you in a separate classified intelligence briefing, the ships of the task force are to remain south of East Timor at all times. Your naval units must under no circumstances move north of Ilheu da Jaco - the small island at the eastern tip of East Timor.
4. You will land your Marine Expeditionary Brigade on the southern coast of East Timor, then move inland to engage, defeat, and disarm the Indonesian forces operating there. Your troops will remain to provide protection and assistance to the local population, until the United Nations can consult all parties to bring about an end to the long-running conflict.
5. An operational plan "Saber" was despatched last night via communications satellite and downloaded into the battle-management computers aboard your flagship Tarawa. You are free to modify or adapt this as you see fit, or to use an alternative plan of your own.
6. You may open fire against the Indonesian forces without further authorisation from the US Government or the United Nations. If, prior to the start of hostilities, Indonesian aircraft approach your own aircraft or fleet in a manner you judge to be a possible threat, you may treat them as hostile.

a possible threat, you may treat them as hostile.

While carrying out these orders, you are to keep the following constraint in mind. Indonesia has for many years been an ally of the US. In the hope of quickly repairing the damage to relations between the two countries which Ocean Saber must inevitably cause, the President wishes this campaign to be kept "low key" and resolved with the minimum amount of force necessary to get the job done.

The President has also asked me to convey his concern that you are being asked to carry out this mission with such limited forces. But even had a second Marine Expeditionary Brigade been available at short notice, or guided-missile cruisers for extra anti-aircraft protection, both he and State Department believe that their use would be counter-productive with a new round of international arms-reduction talks due to start within months. For the US to use the level of military force which the Joint Chiefs of Staff would have preferred on purely military grounds could also prove an embarrassment to US foreign policy, allowing unfriendly nations to raise charges of "Imperialist bullying."

The best intelligence information available from Djakarta and from the East Timor resistance movement leads the US Government and the UN to believe that a swift intervention will not only prevent large-scale loss of life by the civilian population of East Timor, but could also bring about a collapse of the current military dictatorship, and a return to democracy for all the people of Indonesia.



SECTION

III

QUICK START

QUICKSTART

When you've just got back from the computer store, ripped the shrink wrap off the box and unpacked the game, the chances are you don't want to get bogged down in reading a manual and mastering all the details of running a task force - you bought the game in order to fly. AV-8B Harrier Assault is designed to give you many hours of game play, simulating all aspects of both V/STOL and carrier flight operations, but for the moment we'll ignore these and get you into the cockpit and into the air.

Even if you are an experienced flight simulation enthusiast, we recommend that you fly both of the sample missions detailed below. Flying them will give you a useful overview of the entire game, including the process of planning and flying missions. The experience you'll gain on these missions will help you understand the other sections of this manual.

First you must install the game onto your hard disk and get the simulation running. The software is not copy protected, so you should have no problem in getting it installed and started.

Once the game loads, you'll see an introductory sequence showing an AV-8B rising from the hanger of the amphibious assault ship USS Tarawa to the flight deck. Tarawa is the flagship of the task force, and once this animated sequence has ended, you will be placed in the vessel's command center.

The two AV-8B missions described below will give you a chance to get airborne and fly a simulated V/STOL fighter.

STARTING A BATTLE PLAN AND FLYING YOUR FIRST MISSION

Starting the Action

1 Run TAWADS

All battle planning and control of the landing operation is done using the Tactical Amphibious Warfare Data System (TAWADS) in the CommandCenter aboard the Tarawa. Full instructions on how to use this system are given in the Task Force Commander's Manual, but in this section we'll give you enough information on TAWADS to get the campaign started and fly your first missions.

The game will start in the Command Center of Tarawa. To start the action the commander must instruct the TAWADS battle computer to commence operations with SABER, the pre-loaded battle plan. Click on the TAWADS screen (the central monitor showing a map of Timor on screen). This will open the TAWADS interface.

2 Activate a battle plan.

Your control pointer is limited to the BATTLE PLAN SELECTION window, which will show SABER as the current battle plan. To start this plan running, click on the GO icon. There will be a short pause as the simulation runs in fast-forward mode, taking the task force from your current position (8am on day 0, 2 hours sailing time from Timor) to the first way point at which flight operations are scheduled. The fleet will now be off the east tip of East Timor, and the time will be 9.30am. Click on the Exit icon (bottom right of screen) to close TAWADS.

Notice that a light is flashing on the white telephone in the foreground. This is to tell you that AV-8B missions are available to be flown. If you don't go to the Pilots Briefing Room to accept a mission, after a short delay the mission will be allocated to a Harrier flown by the computer.

Pre-Flight Preparation

1 Go to Pilots' Briefing Room

Clicking on the white phone will take you to the Pilots' Briefing Room. This is dominated by a large whiteboard display, which currently shows the missions waiting to be flown. Combat Air Patrol is always available if there is a Harrier on deck. The next mission on the list is an interdiction (ground attack) sortie to the east tip of East Timor. This area has only light defenses, so, for your first operational sortie we suggest that you accept this mission. Click on mission HA\1-1 to accept it.

2 Intelligence Briefing

The whiteboard will now give you the following information:

The primary and secondary targets for your mission.

The Flight Plan for this mission, including the assigned way points.

The defenses you are likely to encounter.

Read this information carefully, then click on ACCEPT to continue.

3 Aircraft Arming

The armorers will already have installed a suitable combination of ordnance for this mission.

Click on OK to accept this weapon load.

FLYING THE MISSION

1 Takeoff

You are in the cockpit of your aircraft, and the engine is running. Ahead of you is the flight deck of Tarawa. Press the W key to release the wheel brakes, then 0 (zero) to run the engine up to full throttle. When you reach the end of the deck pull up the nose and press the

G key to retract the undercarriage. From now on, the key(s) you are to press will be shown in brackets.

2 Fly to Target

Your left hand MFD is showing the EHSI navigation display with way point 1 selected - this is your target. Press (/) until the scale at the top right on the EHSI reads "7". Turn the aircraft to keep the line to this way point vertical in the display. When the line shortens and the way point - the small cross at the end of the line - is about half-way between the outer edge of the EHSI display and the aircraft symbol at the center of the display, you are approaching the target and should be able to see it in the forward view. Don't expect the target to appear directly ahead - the Nav system is only as good as the data it received from TAWADs. Minor errors could result in the target appearing to one side or other of the flight path.

3 Attacking the Target

You will be using Hydra unguided rockets to attack the target (Read the weapons section of the "AV-8B Pilot's Manual" if you want to learn more about these.) Press (backspace) until HYD (followed by a number) appears at the bottom left of HUD. This indicates that the Hydra rockets have been selected, the number showing how many rounds each of the underwing launchers can carry. A T-shaped marker in the HUD shows the predicted impact point of the rockets - fly until these are over the target then press the fire button or (space) to release the rockets.

4 Return to Tarawa

Cycle through the way points on the EHSI display (using the ; key) until a T is shown at top right of display. This is a TACAN radio navigation beacon carried by Tarawa as a navigation aid for its aircraft. Either fly back to Tarawa using the EHSI display to guide you, or select the autopilot (A) and just sit back and watch it do the work of flying you back and landing the aircraft. Even if you've flown back manually, we'd recommend that for your first few flights you turn the autopilot on for the landing.

When you have landed, ask for a debrief by pressing (Ctrl D). This will take you to the Pilots' Briefing Room. A summary of the success of your mission will be shown on the whiteboard.

If you would like to fly another mission, click on the right hand monitor in the briefing room to see what's available to be flown.

Time Control

If no AV-8B missions are available to be flown, you can speed up the simulation, "fast forwarding" to the point where the next batch are ordered. To do this, go to the command centre, click on the TAWADS console, then click on the digital clock at the top right of the map display. A menu will open, offering the following options:

Stop Time

This pauses the simulation.

Normal

The simulation runs in real time - this is the normal operating mode when playing the game.

Fast

The simulation runs at four times normal time. This can be useful while units are on the move, but little else is happening - for example, if landing craft are heading from the assault ships to the beachhead.

Step 1 Min

This is an alternative method of temporarily speeding up the game.

Step Next Mission

This advances the game to the point where the next mission is about to be launched. This allows the player to "fast forward" through parts of the plan in which no operations are to be launched. For example, plan SABER contains relatively few night missions for the AV-8Bs. If none

are scheduled, selecting "Step next mission" will advance the simulation to dawn of the next day.

Pausing the Game

You can pause the simulation at any time to cope with phone calls or other interruptions. When aboard Tarawa, go to the Command Center and click on its digital clock. If you're in the cockpit flying a mission, press the P key.

A MORE ADVANCED SESSION

When you're ready to learn more about the game, the next sortie to be described will show you how to create an immediate mission (one not contained in the battle plan), fly it, then save the game state.

This example follows on from the previous one, and assumes that it is has been flown. If you've flown other sorties in the meantime, you'll have quit from the game, then reload it, restart plan SABER, and reflly that first mission (or let the computer do it for you.)

Checking on Success in TAWADS

When you have flown your interdiction mission (if you survived) you will receive a pilots' debrief telling you how successful you have been. However, as the commander, you will want more of an overview, telling you how that mission fitted into the "big picture" of the overall campaign. While you were busy with your own sortie, other military operations have been under way.

To get this you must run TAWADS again.

1 Run TAWADS

From to command control room click on the TAWADS screen, this will run the TAWADS computer.

2 Zoom into the Target

Your previous mission was to attack a fixed base on Jaco Island, at the east end of the main island. Zoom the map view into this island by clicking with the pointer over the island until the name "Jaco" appears next to a white square indicating a fixed base or town. You may have to move your map view to keep Jaco near the center of the screen. This is done by clicking on the MAP SCROLL icon (four arrows) at the bottom left of the screen.

3 Open the Intelligence Window

Click on the Intelligence icon (at the top right of the screen) This will open a window over the top right corner of the map.

4 Select the Base to Get an Intelligence Report

Click on the white square by Jaco with the left (select) button, the Intelligence window will show the state of the selected object - in this case, Jaco. This is an Indonesian military base containing two buildings - the information window will display the number remaining.

If you have been very successful, this will read 0, but is more likely to be 1 or even 2! We will assume that one of the targets remains, requiring the creation of an unplanned mission to send another aircraft back to Jaco Island to attack the remaining target.

Creating an Immediate Mission in TAWADS

1 Open the AIRPLAN Window

Click on the AIR PLAN mission icon (near top left) - a window will open top left with the words HARRIER WAY POINTS in it. You must now enter the way points for the mission.

2 Enter Mission Way points

Double click with the pointer over Jaco, a red way point icon will appear (a pyramid with the top cut off) under the pointer. You have now indicated to TAWADS that Jaco is to be a way point for the new mission.

3 Change the Way point Type

Click on the background of the HARRIER WAY POINTS window to open its sub-menu. Click on PRIMARY TARGET. This action tells TAWADS that Jaco is not a navigational way point, but a target to be attacked.

4 Finish the Mission Entry

Click on the EXIT icon in the HARRIER WAY POINTS window to finish the entry of the mission- this window will close.

5 Exit TAWADS

Clicking on the TAWADS exit icon to exits the TAWADS system.

Selecting and Flying the Mission

The red light on the Pilots' Briefing Room telephone will be flashing. Click on the phone to go directly to the briefing room. Your new mission will be shown as the second on the whiteboard. It will be named:

INTERDICTION H\0-0 - Primary Target JACO

PRIMARY TARGET JACO

Follow the instructions in earlier PRE-FLIGHT and FLY MISSION sections to fly mission. As you fly combat missions, you will hear the sound of explosions. These are the result of ground-based combat between the Marines and the Indonesian defenders. When the mission is completed you will be returned to the Pilots Briefing Room. Clicking on the telephone will take you back to Command Center.

Flying an Air Combat Mission

To get your first experience of air-to-air combat, go to the Command Center, and use TAWADS to create an Immediate Mission with one of the airstrips on the south coast of East Timor specified as the primary target. Go to the Pilots' Briefing Room and accept the newly-created mission. As you approach the airstrip, defending fighters should try to

intercept you. Once you're familiar with the landscape of East Timor, you can simply go to the Pilots' Briefing Room, accept the Air Combat Mission which is normally available, then head for an enemy air base.

SAVING GAME STATE

Assuming that you have been fairly successful in your attacks on Jaco Island, we will now save the state of the game, so that you can return to it in the future.

- 1 Click on SAVE icon in the Command Center (a diskette on the table). This will open the SAVE/LOAD screen.
- 2 Click on one of the 10 available slots. It will become highlighted.
- 3 Click onto the Save Game icon (an arrow pointing at a disk).

The current game state will be saved to the hard disk, and the selected slot will now contain the name of your saved state. It should read something like SABER 0/9:50. The name is made up to the name of the plan currently being run, plus the current date and time. The example shown contains Plan SABER at the state it had reached by 9:50 AM on day 0 of the campaign.

- 4 Click on the exit icon to return to the command center

This saved game can be retrieved at any time by re-entering the SAVE/LOAD screen, clicking on the slot which contains the saved game, then clicking on the Load Game icon (an arrow pointing away from a disk).

Full details of the SAVE/LOAD facility are provided in Section 7 of the manual "Aboard the Tarawa".

KEYBOARD CONTROLS

Engine & nozzles

Enginethrust:	1 to 0 (0% to 100% in 10% increments) or
Increase thrust:	
Reduce thrust:	
Nozzle position:	SHIFT 1 to SHIFT 0 (0 deg to 100 deg in 10 degree steps) or
Raise nozzles:	SHIFT
Lower nozzles:	SHIFT +
Engine on/off:	E

Flight Controls

Roll left:	LEFT ARROW or Joystick or Mouse
Roll right:	RIGHT ARROW or Joystick or Mouse
Pitch up:	DOWN ARROW or Joystick or Mouse
Pitchdown:	UP ARROW or Joystick or Mouse
Rudder left:	<
Rudder right:	>
Pitch trim +:	PAD +
Pitch trim -:	PAD-
Remove Pitch trim:	PAD*
Calibrate joystick:	Z
Autopilot off/on:	A
Airbrakes:	B
Wheelbrakes:	W
Landing Gear up/down:	G
Eject:	Ctrl-E

Weapons & Nav system

Drop flare:	F
Drop chaff:	C
Radar altimeter on/off:	R
Next weapon:	BACKSPACE
Weapons in salvo:	N
Change bomb aiming mode:	
Cycle left MFD:	
Cycle right MFD:	
EHSI range:	
Next way point:	
FLIR on/off:	I
Fire weapon:	Space, Joystick 1, Mouse Left
Mark ground target:	Enter, Joystick 2, Mouse Right
Jettison all unused weapons	Ctrl-R

Views

Cockpit view

Lookup/down:	F1
Forward view:	F2
Left 60 deg:	F3
Right 60 deg:	F4
Left 120 deg:	F5
Right 120 deg:	F6
Zoom in:	PAGE UP (If NUM LOCK is off)
Zoom out:	PAGE DOWN (If NUM LOCK is off)

Outside Views

Missile View:	M
Enemy View:	J
Outside view:	V
Camera view:	O
Rotate left	F7
Rotate right:	F8
Rotate up:	F9
Rotate down:	F10

TimeControl

Fast time:	X
Pause:	P
Single step:	S (when paused)

Game configuration

Mouse:	Ctrl-M
Joystick:	Ctrl-J
Keyboard:	Ctrl-K
Advanced model:	Ctrl-A
Simple model:	Ctrl-S
Menus:	ESCAPE
Return to Command Center:	Alt-X
TSR keys on:	Alt-K

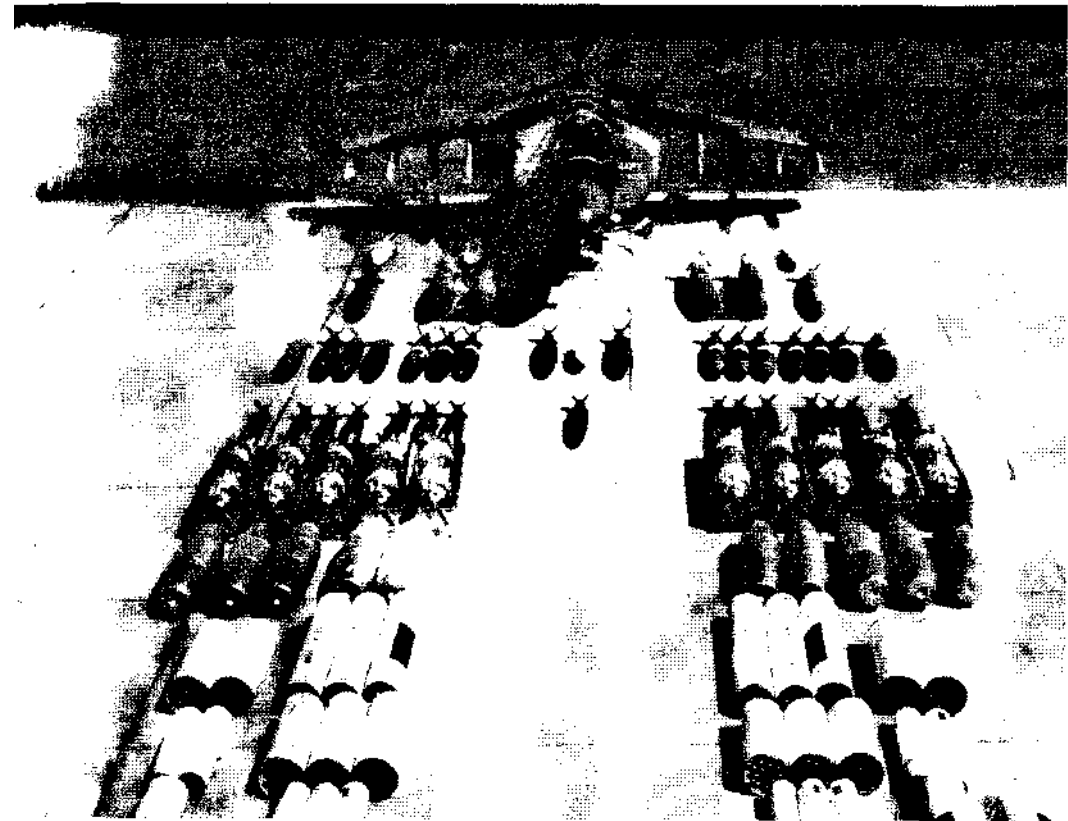
(This opens a window which allows you to give keyboard commands to any Terminate and Stay Resident routines you may have in your computer. Most players will never need to use this facility.)

Engine noise on/off:	Q
All sounds on/off:	Ctrl-Q



**SECTION
IV**

AV-8B PILOTS MANUAL



AV-8B PILOTS MANUAL

The McDonnell-Douglas/British Aerospace AV-8B Harrier II is the latest member of a unique family of vertical/short take-off fighter aircraft. Originally designed in Britain, and taken into service by that nation's Royal Air Force, Harrier was later adopted by the US Marine Corps as the AV-8A. A collaborative effort involving the US and UK finally resulted in today's much-improved AV-8B.

Only 46ft 4in long and 30ft 4in in wingspan, Harrier is smaller than many present-day fighters, and closer in size to the General Dynamics F-16 Fighting Falcon than aircraft such as the McDonnell Douglas F-15 Eagle and F/A-18 Hornet. The factor which makes the Harrier family unique is that the thrust of its engine can be deflected from rearward to downward, allowing the aircraft to take off and land vertically, and to hover.

Harrier may not qualify for the adjective "beautiful" but its curved lines are evidence of its ancestry from the classic British Hawker fighter design team - an organization which firmly believed that if an aircraft looked right, it was right. Like another famous British export, the Rolls Royce automobile, the AV-8B has its own very distinctive appearance.

Its most distinctive feature is that its single engine does not have a single jetpipe in the rear fuselage, but a total of four - two on either side of the center fuselage. A single cockpit control allows the pilot to move all four in unison through an angle of more than 90 degrees. Known as "thrust vectoring", this technique is used for vertical takeoff and landing, and hovering. It can also be used in combat to increase the aircraft agility - this is known as "viffing" (Vectoring In Forward Flight), and you'll learn how to do this later in this section of the manual.

Vertical take-off and landing is only possible if the engine thrust is greater than the total weight of the aircraft. This is usually the case when landing, since most of the fuel will have been used, but can be a problem at takeoff if the aircraft is carrying a heavy weapon load. In such cases, deflecting the nozzles downward by 30 - 40 degrees allows the aircraft to get airborne after a very short run. This procedure is widely used, so Harrier can be thought of as a Vertical/Short Take-Off

mid Landing (V/STOL) or even a Short Take-Off/Vertical Landing (STOVL) aircraft.

The use of afterburning would turn the four nozzles into runway-destroying blowtorches, so Harrier does not use this technique. All the thrust must be provided by normal engine power. The sheer size of the engine needed to provide the required amount of thrust gives the aircraft its relatively wide center fuselage and huge "elephant ears" air inlets, while the absence of an afterburner limits the aircraft to subsonic speeds. Maximum speed at sea level is around 575 kts. (Mach 0.87), rising to Mach 0.91 at altitude.

Tactical range - the distance the aircraft can fly, loiter for long enough to perform a useful military mission, then fly back to base - depends on the height at which you fly and the weight of weapons carried. A typical figure with a good bomb load would be around 480nm.

A full history and description of the Harrier family up to and even beyond today's AV-8B is provided at the rear of this manual, but this information is not needed in order to fly the aircraft.

YOUR WEAPONS

The AV-8B can carry five types of ordnance - guided missiles, "dumb" bombs, laser-guided bombs, cluster munitions, and unguided rockets. It is also equipped with two 25mm cannon.

Two types of guided missile are available. Both are homing missiles, and must be locked onto the chosen target before being fired. (You'll learn how to do this when flying the Part Task Trainer missions described later in this section of the manual.) Once fired, the missile will home automatically with no further action needed on your part.

AIM-9M Sidewinder

The AV-8B would normally carry four AIM-9M when deployed in the air-to-air role, or two (one on each outboard wing pylon) for self-defense

when on strike missions. The AIM-9 flies at a speed of around Mach 2.5, and uses a nose-mounted infra-seeker seeker to home onto an aircraft target. The seeker responds to heat. Early-model AIM-9s could only home on the hot engine exhaust of the target, but the -9M model is sensitive enough to home onto the aircraft from any direction. Maximum range is around 19,000 yards when fired against an approaching aircraft, but falls sharply when fired against a retreating target. If you find yourself on the tail of an enemy aircraft, close the range to a few thousand yards before firing.

AGM-65E Maverick

On strike missions, the AV-8B can carry up to four AGM-65E Maverick missiles. These have a maximum range of up to 26,000 yards, so can be fired from outside the range of light SAMs and AAA defending the target. The AGM-65E version of Maverick was specifically designed for close-support of Marine operations. It homes not against heat but a bright spot of laser light. When a target needs to be attacked using Maverick, the Marines in the front line will use a man-portable laser designator to shine laser light onto the target. The small amount of laser light reflected by the target will be detected by the seeker head of the AGM-65E, which will home onto the illuminated target. The warhead weighs 300 lbs., so a single round should be enough to destroy a tank, bunker, or artillery position.

AGM-88 HARM

The High Speed Anti-Radiation Missile is a specialized weapon developed to destroy enemy radars. Its sophisticated seeker head is designed to detect and lock onto radar signals, guiding the weapon to a direct hit on the radar. The only counter available to an enemy is to turn off the radar as soon as the Harm is launched. If he turns off too late, Harm will continue its flight by "dead-reckoning", landing as close as possible to the radar. Maximum range of Harm is about 10 miles.

General Purpose Bombs

Often referred to as "iron" bombs, these simple but effective weapons have been used in combat since the First World War. They take the

form of streamlined metal casings packed with explosives, and fitted with fuses and stabilizing fins. For low-level strikes, retarded bombs are used. These incorporate a drag-producing device such as pop-out fins or a small tail-mounted parachute. These slow the weapon after release, so that the aircraft will be a safe distance away by the time the bombs hit their target. Bombs range in weight from 250 lbs. to 2,000 lbs. The AV-8B can carry up to 16 of the smaller sizes, but only a few of the largest.

"Iron" bombs are a relatively inexpensive weapon, but are only as effective as the pilot who aims them. A bomb which misses the target is a bomb wasted. During the Vietnam war, half the bombs released by US pilots landed within 150 - 200 ft. of the target. During Desert Storm in 1991, better training and improved aircraft had but this figure to around 30 - 40 ft. Despite this small distance, the success rate of "iron bomb" attacks against Iraqi targets was around 30 per cent. Tanks, bunkers, and troops who have time to "dig in" are heavily protected, so only a direct or near-direct hit will be effective.

Laser-Guided Bombs (LGBs)

First used during the Vietnam War, LGBs (often known as "smart" bombs") combine the body of a general-purpose bomb with an add-on laser seeker and control fins. Like the AGM-65E Maverick, these rely on laser designation by friendly ground forces. They need to be locked on to a target before being released, then home automatically against targets. LGBs combine the explosive power of a bomb with the precision of a guided missile.

The most common US patterns are the GBU-10 (based on the Mk 84 2,000 lbs. bomb), the GBU-12 (based on the Mk 82 500 lbs. bomb), and the GBU-16 (based on the Mk 83 1,000 lbs. bomb). During Desert Storm, US LGBs had a success rate of around 90 per cent.

Cluster Munitions

These are the pilot's equivalent of a blast from a shotgun. Like a general purpose bomb, cluster munitions are unguided, and thus relatively inaccurate. The explosive payload consists not on a single large explosive charge, but of hundreds of small bomblets. Just before

impact, a cluster munition bursts open, scattering these over the target area. Cluster Munitions are highly effective when used against tanks, soft-skinned vehicles such as trucks, and troops caught in open terrain. Several types are in US service. The Rockeye Mk20 Mod 0 is designed for use against tanks, and contains 247 anti-tank bomblets, each weighing just under 2 lbs.

Unguided Rockets

Carried in underwing launch pods holding between six and 18 rounds, Hydra 2.75" rockets fly an unguided course to the target. In the hands of a pilot with a steady aim, unguided rockets can be used against the same sorts of targets as cluster munitions. (When flying your first combat sorties, you'll find the Hydra rocket an effective and easily-aimed weapon. Equip your aircraft with two or more 18-round launchers, and select a four or eight-round salvo size.)

25mm Cannon

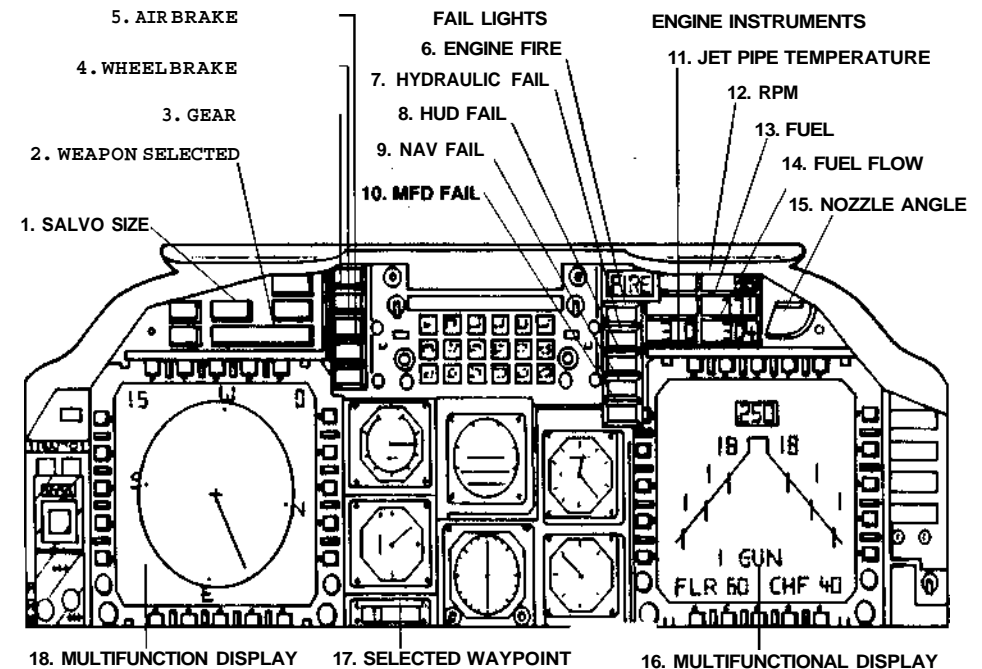
Like most fighters, the AV-8B is fitted with a gun. The GAU-12/U Equalizer is a five-barrelled rotary cannon based on the configuration of the legendary Gatling. Driven by pneumatics, the weapon has a maximum rate of fire of 60 rounds per second. The 25mm ammunition comes in three varieties - Armor-Piercing Incendiary (API), High-Explosive Incendiary (HEI), and Tactical Personnel (TP), and has a muzzle velocity of 3,500 ft./sec.

The cannon is not mounted within the fuselage, but in one of two fairings on either side of the lower fuselage. The port-side fairing contains the gun, the starboard fairing the weapon's 300 rounds of ammunition. Rounds pass from the magazine to the gun via a linkless feed.

Each pod incorporates a flat surface known as a strake. When the undercarriage is lowered, the gear door is positioned across the fuselage just behind the strakes, while a retractable fence is extended in front of them. The resulting "box" traps the cushion of air created by the engine exhaust gases bouncing from the ground as the aircraft hovers at low altitude, creating extra lift.

THE AV-8B COCKPIT

REVERSIONARY WEAPONS DISPLAYS



The cockpit display in this simulation is a close replica of that in the real aircraft. The game designers have made some minor modifications in order to improve the player's forward view, but apart from that, the basic layout of the cockpit would be familiar to any AV-8B pilot. The only AV-8B pilots who might find it unfamiliar are those of Britain's Royal Air Force, which has fitted an extra display screen in the cockpit.

Like the simulation model itself, the cockpit is as realistic as possible while still being able to run on a personal computer. There are more accurate simulators, but they're classified, your annual salary wouldn't match the price tag, and you'd have to undergo a long interview at your nearest USMC recruiting office, the rigors of "boot camp", then a long training course before getting your hands on them.

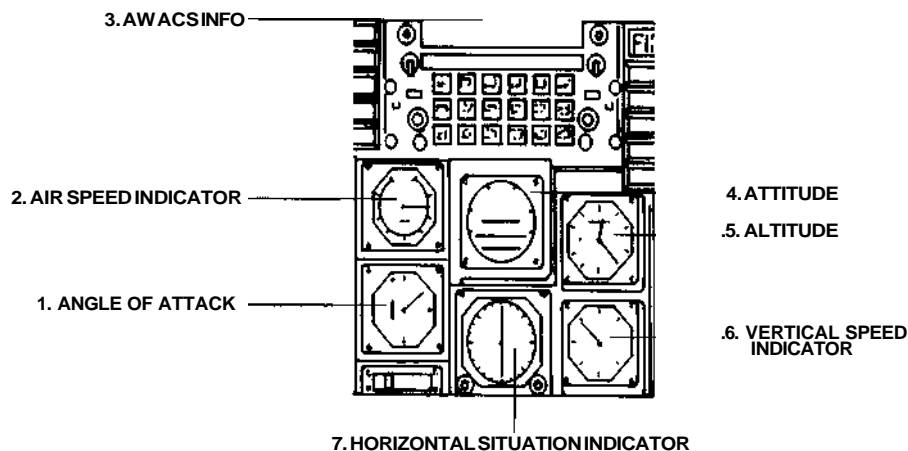
If you've used other flight simulators, you may find this one a little difficult at first. The aircraft simulation is based on a sophisticated aerodynamic model designed to provide as true a representation of the aircraft's performance as possible. Although this makes AV-8B Harrier Assault one of the most realistic simulators ever written for a personal computer, it makes the aircraft quite sensitive to control inputs, giving it a more "live" feel than on many other products. The novice player will find that it's easy to overcorrect with the controls.

If this is the case, pressing Ctrl S will switch in a simpler model, with smoother and more easily controlled responses. This may be closer in "feel" to the flight simulator software you're used to, and will help you get into the game as quickly as possible, without having to worry about the complexities of the full aircraft model.

When you're ready for a greater challenge, pressing Ctrl A will return you to the advanced model, giving you a more accurate simulation of the real aircraft and making greater demands on your piloting skill. Once you've become used to this more accurate simulation, you're unlikely to return to the simple model. The advanced model has a fascination of its own.

Flight Information

MAIN INSTRUMENT PANEL



The pilot has six basic sources of information - the view through the canopy, the Head-Up Display (HUD), two Multi-Function Displays (MFDs) and a single Up Front Control Panel (UFCP). All of the above data is duplicated on conventional instruments mounted on the aircraft control panel. These will allow the aircraft to keep flying if the HUD fails due to combat damage. These reversionary instruments are mounted in two rows at the center of the instrument panel:

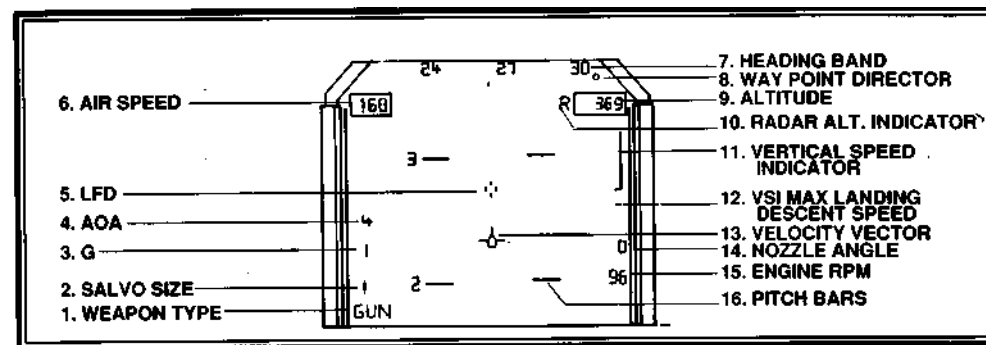
ASI Attitude Altitude AOA
AOA

Each will be described after the HUD or MFD function it duplicates.

Looking Around

The normal view in flight is forward. Pressing the F1 key lets you look up. F3 and F4 look 60 degrees to the left and right respectively, while F5 and F6 allow you to look 120 degrees backward over your left and right shoulders. F2 returns your view to the normal forward direction.

The Head-Up Display (HUD)



The primary source of information for the pilot is the Head-Up Display (HUD), a reflective surface mounted ahead of the pilot's eyes. Projected onto this is all the flight, navigation, target and weapon-aiming information needed to carry out a combat mission.

The main symbols visible in the HUD are used for navigation:

LFD

Directly in the center of the HUD, the Longitudinal Fuselage Datum (LFD) shows the direction in which the aircraft nose is pointing. This is a fixed mark. If the HUD fails during a combat mission, the LFD could be used as a simple sight for the cannon or unguided rockets, but the pilot will have to aim high to compensate for the ballistic drop of the projectiles caused by gravity, and off to one side or another to compensate for the turn rate on his aircraft.

Velocity Vector

This moving marker shows the direction in which the aircraft is currently flying. In normal flight, this will be close to the horizon. If it's above the horizon, you're gaining height; if it's below the horizon, you're losing height. If the aircraft is in a dive, it will be pointing at the ground, showing the point where the aircraft will crash if it remains on this course and speed.

V/STOL Velocity Vector

The normal Velocity Vector cannot cope with the slow speeds associated with nozzle-borne and hovering flight. At speeds of less than 100 kts. (knots), a V/STOL velocity vector mark automatically appears in the HUD. This will give some indication of where the aircraft is currently headed, but as the airspeed slows to a hover, even this marker will not be reliable. When the predicted touchdown point falls below the aircraft nose it can no longer be seen in the HUD, so the marker falls to the bottom of the HUD field of view and stays there.

Pitch Bars

A series of vertical pitch bars indicate the amount by which the nose is above or below the horizon. These bars remain parallel to the horizon at all times, so can be used to keep the wings level when the horizon is not visible in a steep climb or dive. The bars are at 10 degree intervals, with 90 degrees being represented by a cross. If one of these cross markers is in the center of the HUD, the aircraft is either climbing vertically, or is in a vertical dive.

Aircraft attitude is also displayed on the artificial horizon, the central instrument on the top row of three circular dials. The single bar on this instrument is the equivalent of the zero-degree pitch bar in the HUD. It remains parallel to the horizon, and moves up or down to indicate aircraft pitch.

VSI (Vertical Speed Indicator)

A vertical bar at the right hand side of the HUD indicates the speed at which the aircraft is gaining or losing height, a small horizontal marker protruding to the left of the line indicating the center point - zero rate of climb. The further the VSI line stretches above this zero point, the faster you're climbing; the further it stretches down, the faster you're losing height. A second marker below the center point shows the maximum descent speed which the aircraft undercarriage can withstand. VSI information is also displayed on the right hand analog instrument of the bottom row of three.

Altitude

A box at the upper right of the HUD shows the aircraft height in feet. The aircraft has two altimeters - the radar altimeter indicates height above the terrain, while the barometric altimeter shows height above sea level. You can switch from one to the other using the R key; when the radar altimeter is in use, an "R" symbol will be displayed in the HUD just to the left of the altitude box. The radar altimeter is useful in low-level flight, since it shows your height above the ground. It only operates at heights of below 5,000 ft. Above that height, you'll need to use the barometric altimeter. An analog altimeter is also provided at the top left of the array of six round-dial cockpit instruments. The large pointer makes one complete revolution per 1,000ft, while the smaller advances by one "hour mark".

Airspeed

A second box at the upper left of the HUD shows airspeed in knots (nautical miles per hour). This information is shown in analog form on the air speed indicator (ASI) at the top left of the bank of six cockpit instruments.

Heading

A horizontal band running across the top of the HUD shows the current heading in tens of degrees. 00 is north, 09 is east, 18 is south and 27 is west. The direction in which you're flying is indicated by a small vertical tick below the heading display. A V-shaped steering cue visible above the heading display is linked to the aircraft Nav system. It indicates the direction you must steer to reach the next navigation way point or target. This gives no indication of range, and can only indicate angles within the HUD field of view. If the steering cue is at one end of the heading indicator, turning in that direction will eventually bring it moving toward the center of the heading indicator. (Target and way point bearings, along with distance to be flown to reach them, are shown in the EHSI display which is described later in this section.)

A second compass if provided in the form of an analog horizontal situation indicator (HSI) at the center of the bottom row of instruments.

Nozzle Angle

The AV-8B Harrier II obtains its hovering and VTOL capability from the fact that the four nozzles of its Rolls-Royce Pegasus engine can be moved from the full aft position to vertically downwards. The topmost of the two numbers visible directly below the VSI indicator shows the angle to which the nozzles are currently set. This varies from 0 (fully aft) to 110 (110 degrees). Nozzle angle is also shown in analog form on an instrument at the top right of the instrument panel. A small mark on the edge of this instrument shows the correct nozzle angle for hovering. This is not 90 degrees, but 80 degrees - Harrier sits on its undercarriage with a pronounced nose-high stance.

There are two ways of moving the nozzles. Shift = and Shift - swing the nozzles downward and rearward respectively, while Shift 1 to Shift 0 select the nozzle position in ten degree steps between 0 degrees and 100 degrees.

Engine RPM

The number directly below the Nozzle Angle shows engine RPM. Full thrust corresponds to a figure of around 98 per cent, pre-takeoff idle is around 30 - 40 per cent. RPM is also shown numerically on the instrument panel.

AOA (Angle of Attack)

This shows the angle between the fore-and-aft axis of the wing (an imaginary line drawn between the wing leading and trailing edges) and airflow across the wing caused by the aircraft's forward velocity. Increasing the AOA by a small amount increases the amount of lift generated by the wing. Take this process too far, and the wing stalls (typically at an AOA of around 20 degrees).

When the wing stalls, the airflow across its surfaces is disturbed, and the lift falls off dramatically. In a conventional aircraft, control of the aircraft is momentarily lost, the nose falling until the AOA is low enough to restore normal lift. By swivelling its engine nozzles, an AV-8B can substitute engine thrust for lift, so will remain controllable beyond the stall, and even down to the hover. An analog AOA indicator is available at the bottom left hand of the six cockpit instruments.

G Force

This shows the G force currently being experienced by the aircraft and its pilot. The airframe can accept more G force than the pilot. At G levels of more than around 9 g, he will begin to "grey out" as the G force drains blood from his head and upper torso to the lower torso and legs. This causes a dimming of vision, or if the G load is high enough, loss of consciousness. Pushing the control column sharply forward can have the opposite effect, the resulting negative G forces pushing blood from the pilot's torso to his head. This will create "red out."

Forward-Looking Infra Red (FLIR) System

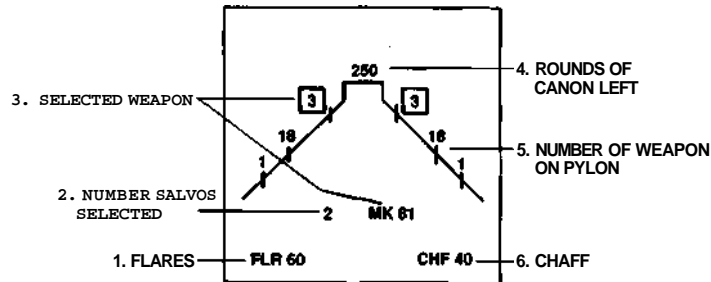
The version of Harrier you are flying is equipped for night attacks. The time of day is reflected by changing light level in the external view seen through the canopy. This will dim during dawn and dusk, and darken further at night. For night flying you must use the FLIR night vision system. This is turned on by pressing the I (capital i) key, and will project a full-sized green thermal image of the outside world into the HUD, superimposing this on the external scene.

Multi-Function Displays

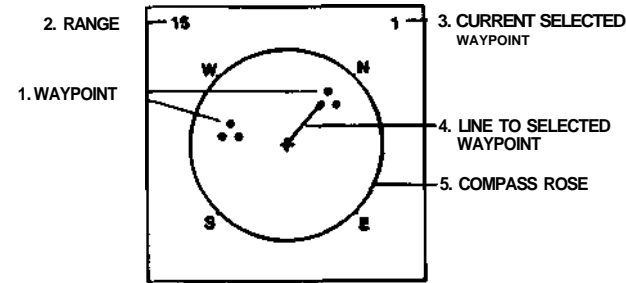
The cockpit also includes two Multi-Function Displays - the screens which can be configured to one of four modes. Use the [key to cycle the left MFD through its available modes, and the] key to cycle the right-hand MFD. In this way, you can set the MFDs to the configuration with which you feel most comfortable. The same display cannot be selected on both MFDs at the same time, so a little manipulation may be needed to get the displays into the configuration you prefer.

STORES DISPLAY - This shows the number and type of weapon available on each of the aircraft's underwing pylons, also the number of rounds of cannon ammunition, chaff cartridges and flares available for use. It also indicates which type of weapon is currently selected, and in the case of bombs, laser-guided bombs or unguided rockets, the number of weapons which will be released when the fire button is pressed.

WEAPONS



EHSI - The Electronic Horizontal Situation Indicator (EHSI) mode shows the aircraft in symbolic form, surrounded by a compass rose. This display is centered about the aircraft. The top of the screen always represents the direction directly ahead of the aircraft. As the aircraft turns, the compass rose



moves to the correct orientation. When a way point is selected, the EHSI displays this as a small cross, and draws a steering line whose angle indicates the direct to steer, and whose length indicates the distance to be flown.

The steering information is echoed by the steering cue at the top of the HUD. The scale of the EHSI display can be toggled by the / (slash) key, so that the distance from the center of the display to the compass rose is 7, 15, 30 or 60 nautical miles. The other type of marker seen on the EHSI is a cluster of three dots. These show all the other way points currently with the range setting of the EHSI.

Before takeoff, a series of way points is automatically stored in the aircraft's Nav system, and you'll be given details of these when you're assigned a mission in the Pilots Briefing Room. The system can store up to eight way points (numbered 1 - 8), also a way point T (the TACAN beacon on Tarawa), and a way point zero. The Nav system can be switched from one way point to another by pressing the ; (semicolon) key. The way point in use is indicated at the top right-hand corner of the EHSI, and on a readout at the foot of the instrument panel.

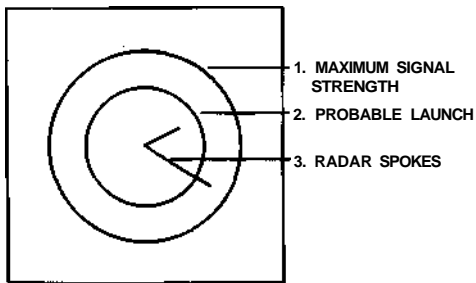
Way point T - the TACAN radio-navigation beacon carried by Tarawa - is an important feature of the Nav system. Selecting way point T at the end of a mission allows the pilot to find his way back to the ship. If Tarawa is sunk, TACAN will no longer be available, but in practice this will not be a problem. Lose Tarawa, and you've lost the game.

You can set way point zero in flight to mark a target of opportunity - a target you have not been briefed on, but noticed on your journey to the target you're scheduled to attack. A target of opportunity can be inserted into the Nav system by pointing the HUD LFD at it and pressing the 'Enter' key. If you have unexpended weapons left after knocking out your assigned target, you can get the Nav system to fly you back to way point 0 so that you can use the remaining weapons on this target. To help you re-acquire a target of opportunity, its position on the ground is marked by a cross in the HUD field of view.

If the MFDs fail in flight, the analog; HSI in the center of the bottom row of instruments will provide you with the navigation information needed to find the carrier. This is always set to follow the TACAN beacon on Tarawa. Like the EHSI, the analog HSI is stabilised with respect to the aircraft. The green end of the moving indicator shows the bearing of Tarawa.

Radar Warning - Like the EHSI, the Radar Warning display is aircraft stabilised, with the direction of forward flight corresponding to the top of the display. Any spoke-like lines appearing from the center towards the circular outer indicate that a sensitive receiver within the aircraft has detected a radar transmission on that bearing. The length of the line gives an indication of

RADAR WARNING RECEIVER



the strength of the detected signal. The more powerful the signal, the closer the threat radar is likely to be. Concentric circles on this display help the pilot judge the relative strength of any signals detected. A Missile Launch Warning detector will sound a warbling alarm tone whenever a SAM or air-to-air missile is launched against your aircraft.

ARBS - The final MFD mode is linked to the aircraft's nose-mounted Angle Rate Bombing System. This consists of a laser spot tracker linked with an imager. This is used for Automatic Bombing, and is

described later in this section.

Up-Front Control Panel

The complex electronic warfare (EW) systems aboard Tarawa and the other ships of the task force will monitor Indonesian tactical communications, so will be able to tell if fighters are likely to intercept your mission. The airspace above East Timor is being continuously monitored by Boeing E-3 Sentry Airborne Early Warning and Control (AWACS) aircraft operating from the US base at Diego Garcia in the Indian Ocean, so an E-3 will always be on hand to warn of any enemy fighters if these are operating in your patrol area.

These warnings will appear on the Up-Front Control Panel. Threat hearing will be shown in terms of the clock face, with 12 o'clock being straight ahead, 3 o'clock directly to the right, 9 o'clock directly to the left, and 6 o'clock directly to the rear. Targets marked H are above your altitude, so will probably be fighters. Those marked L are below you, so are probably helicopters. Those marked C-130 are Hercules transports. AWACS data is updated every five seconds.

Autopilot

Pressing the A key will toggle the autopilot off or on. When engaged, the autopilot will fly you to the currently selected way point, and if you don't switch it off, through all subsequent way points. During this time, the normal flying controls will have no effect. When the autopilot is engaged, an AUTO indication will appear in the HUD. An indication will also be presented at the left hand side of the instrument panel.

The autopilot can be used to fly the aircraft while the pilot is busy selecting armament or changing MFD modes, or as a convenient way of flying from one way point to another. If the Nav system is set to way point T (the TACAN beacon on Tarawa), and the autopilot is engaged, it will fly the aircraft back to the ship, and even carry out the landing. Landing aboard Tarawa can be difficult, so beginners will find this facility useful.

The aircraft also incorporates a Stability Augmentation and Attitude Hold System (SAAHS) designed to tame the natural instability which

results from flying partly or totally supported by engine thrust. The aircraft can be flown without SAAHS, but one pilot has described the experience as being "like trying to balance an egg on a knife edge". In this simulation, the SAAHS is always activated, so you shouldn't have too much trouble when trying to hover. To show the capability of the system to journalists taken for demonstration flights in the two-seat trainer version of the aircraft, pilots have been known to take both hands off the controls while the aircraft is hovering.

Fuel

The amount of fuel left in the tanks is shown on an instrument panel indicator. Multiply this figure by 10 to get the amount of remaining fuel in pounds. Judging what will be the "Bingo" fuel state for the mission - the amount needed to get you back to the ship - is not easy. When you get to the combat zone over east Timor, check the amount of fuel you've used. Two, three or even four times that amount might be a reasonable "Bingo" value, leaving you a good margin for emergencies.

Several circumstances could see you running low on fuel during the return trip. Tarawa will have moved since you left her, and could now be further away. Minor battle damage may be causing you to lose fuel at an uncomfortably high rate. If enemy fighters catch you on the return trip, you'd better have enough fuel for a session of dogfighting at full thrust.

When the fuel state drops to "Bingo" level, head for Tarawa without further delay. Unlike a full-size aircraft carrier, Tarawa has no tanker aircraft able to top up your tanks. Get this one wrong, and you'll be examining the Timor Sea in close-up from the comfort of an inflatable dinghy.

Jet-Pipe Temperature

A sensor in the aft section of the engine measures the temperature within the aft nozzles of the Pegasus turbofan, and the result is displayed on the instrument panel. If this rises above normal, you could have an engine problem. If you've taken combat damage, keep a watch on jet-pipe temperature. An abnormally high value could be the first indication of a possible engine fire. If the jet pipe temperature

misbehaves, head back to Tarawa. The maintenance technicians can change an engine in a few hours, but they can't build you a new Harrier if you crash en route due to an engine problem which you've ignored.

Fuel Flow

Mounted to the right of the Jet-Pipe Temperature indicator, this shows the rate at which fuel is being used by the engine.

Undercarriage

Harrier has a novel undercarriage of bicycle form. The main gears are in the lower fuselage, forward and aft of the engine, while two outriggers — one about mid-span on each wing — provide the stability needed to prevent the aircraft tipping over if the ship rolls heavily, or you make a bad landing. Use the G key to raise and lower the undercarriage. It should be raised after take-off to reduce drag. Failing to lower it on landing will send your aircraft to the hanger for extensive maintenance. Undercarriage position is shown on the Indicator Strip (see below).

Wheel Brakes

Undercarriage wheel brakes are controlled by the W key. Attempting the rolling takeoff without removing the brake is bad for the tyres, and could see you crashing to the sea. If the takeoff roll seems slow, hit W, then Shift 5. The thrust from the downward-tilted engine nozzles will probably compensate for your low forward speed. The state of the brakes is shown on the Indicator Strip (see below).

Air Brake

A large air brake is positioned under the fuselage, just aft of the main landing gear. Extending the air brake increases drag, slowing the aircraft. This can be useful in combat, where it can reduce your speed - and thus your turning circle - in a dogfight, or in a diving attack. The

air brake is controlled by the B key, and its position is shown on the Indicator Strip (see below). Just remember to retract it when it's no longer needed!

Indicator Strip

A vertical column of five lamps are mounted to the left of the Up-Front Display. These show the status of several important sub-systems:

Unused	Undercarriage	Wheel Brakes	Air Brake
Unused			

Warnings

A vertical column of warning lamps is mounted to the right of the Up-Front Display. The large FIRE indicator will light in the event of an engine fire. The others will illuminate if any of the following system fail:

Hydraulics	HUD	Nav system	Multi-Function Displays
Unused			

If the hydraulic system fails, your undercarriage and air brakes will be unable to move from their current positions. Break off the mission, return to Tarawa, and make the best landing you can. HUD, Nav system and MFD failures will make effective attacks near-impossible, although the LFD in the HUD can be used as an impromptu sight for the cannon and unguided rockets. Use the reversionary instruments to fly back to Tarawa for repairs.

Further malfunction indications are provided by a vertical row of indicators at the far right hand side of the instrument panel. These warn of sub-system failures, and in practice are of no direct concern to the pilot. If any light, one of the main warning lamps will also be lit, identifying the major system which has been affected.

Ejection Seat

If battle damage causes you to lose control of the aircraft, or if you run out of fuel and are about to crash, press Control E to eject from the aircraft. If you survive ejection, you will be picked up either from

the sea or East Timorese territory, and returned to Tarawa for a post-flight debriefing.

FLIGHT CONTROLS

The main flight control of any modern fixed-wing aircraft is the control column or "joystick", so the easiest way to control the AV-8B simulation is with an analog joystick. Just as in a real aircraft, forward movement of the joystick moves the nose of the aircraft down, putting the aircraft into a dive, while backward movement raises the nose, putting the aircraft into a climb. Moving the joystick to the right rolls the aircraft to the right, while movement to the left rolls the aircraft left.

If your joystick is spring-loaded, the spring force will help you fly by automatically centering the control stick after each maneuver. The force of the springs will also provide a crude representation of the stick forces felt by the pilot.

A joystick needs to be calibrated before playing the game. This can be done in two ways, both of which are available from the aircraft cockpit. Both are described in the Pre-Flight Customization section below.

The next best control method is to use a mouse. You should visualize the mouse as being the top of an imaginary control stick, moving it forward to push the nose of the aircraft down, pulling it back to lift the nose, and moving it right and left to command the aircraft to roll. Unfortunately, the mouse will do nothing to help you return the imaginary control stick to the central position. To get around this problem, pressing the Z key with mouse control selected will re-center the aircraft's flying controls at the current position of the mouse.

The final method of simulating a control column is to use the arrow keys on the keyboard. Once again, the trick is to imagine these as moving the tip on an imaginary control column. The Up Arrow will push the aircraft nose down, while the Down Arrow pulls it up. The Right and Left Arrows command the aircraft to roll. Like a mouse, the Arrow keys can do nothing to help you center the controls. A flight simulation really needs a good joystick. If you don't own one, the advanced aircraft model contained in the AV-8B Harrier Assault software is the best excuse we can think for investing in one.

The other significant flight controls are the rudder and trim. Rudder control is via the < and > keys. In flight, it can be used to make small horizontal aiming corrections, or to final heading corrections when landing. In the hover, it turns the aircraft by operating the yaw reaction jets, while on the ground, it steers the aircraft via its nosewheel.

Pitch trim can be inserted using the + and - keys on the keypad, and removed using the * on the keypad. The + key raises the nose; the - key lowers it.

If you've never used a flight simulator, and are unfamiliar with the controls of an aircraft, we strongly recommend that you read the Primary Training section of part 8 "Flight Training" of this manual.

THE USE OF VECTORED THRUST

Until now, there has been no true PC-based simulation of a vectored-thrust jet fighter. Whether this is your first flight-simulation purchase or the latest of many, you must learn to cope with the aircraft's unique system of vectored nozzles. To help you, the following flight procedures describe how to use this capability. Most are based on flight procedures contained in the official Harrier manual. The fact that they work on this simulation is testimony to the accuracy with which the aircraft has been modelled by the software.

Vertical Take-Off

This can only be flown with light weapon loads. Maximum take-off weight (shown on the right center of the Weapon Loading Screen) must not exceed the maximum engine thrust of 23,800 lbs.

1. Set the nozzles to 80 degrees, then select full engine power.
2. At a height of 50 ft., move the nozzles slowly backwards.
3. At a forward speed of around 180 kts., the wings will generate enough lift to support the aircraft.

Rolling Take-Off

1. Set the engine nozzles to between 40 and 50 degrees, depending on aircraft weight. The heavier the aircraft, the greater the should be.
2. Remove the wheelbrakes, and select full engine power.
3. Apply a slight back pressure on the controls as the aircraft leaves the flight deck, then hold the nose just above the horizontal.
4. When the aircraft reaches a forward speed of more than 180 kts., raise the undercarriage and the engine nozzles.

Tarawa's flight deck is long enough to allow a take-off with the nozzles left fully aft. You will lose around 20 ft. of height in the first few seconds of flight, so keep the nose above the horizontal until the aircraft has regained height.

Short Rolling Take-Off

This is the procedure used to minimise takeoff run when operating out of very short land strips. You won't need to use it in the game; it has been included here for your interest. Try to get airborne in the shortest possible distance while carrying a heavy weapon load.

1. Remove the wheelbrakes, and select full engine power.
2. As the aircraft approaches the end of the flight deck, hit (Shift 5) to set the nozzles to 50 degrees.
3. When clear of the ground, hold the nose just above the horizontal.
4. At a height of 50 ft., move the nozzles slowly backwards.
5. At a forward speed of around 180 kts., the wings will generate enough lift to support the aircraft.

Returning to the Hover

1. Jettison all unused weapons (Ctrl-R).
2. Set the nozzles to 20 degrees.
3. Increase the nozzle angle to 40 degrees as you approach the ship.

4. At an altitude of around 100ft., and about 1,200 yards from the ship, move the nozzles to 90 degrees.

Control in the Hover

Once the aircraft is stabilized in the hover, you'll probably find that it is not over the intended landing spot. To move the aircraft in the desired direction, the line of the vectored engine thrust must be moved from the vertical. There are two ways of doing this.

1. Slightly decreasing the nozzle angle will direct the thrust backward, giving a small forward velocity to the aircraft. Increasing the nozzle angle will move the thrust forward, resulting in a small rearward velocity.
2. Pushing the nose downward slightly will deflect the thrust line enough to move the aircraft forward, while pulling it up will move the aircraft rearward. Using sideways movements of the control column will roll the aircraft slightly in the direction of control column movement.

In both cases, the rudder can be used to turn the aircraft horizontally.

Vertical landing from the Hover

1. Apply power as needed to maintain your height, and use the control column to position the aircraft for landing.
2. Once in position, reduce the engine r.p.m by a few per cent.
3. At touchdown, close the throttle to idle.
4. Move the nozzles to 0 degrees, then apply the wheelbrakes and shut down the engine.

V1FFING (Vectoring in Forward Flight)

The AV-8B has a relatively low top speed and effective ceiling compared to most fighters, but the high level of installed thrust gives it a phenomenal acceleration in flight, while rotating the nozzles forward provides equally impressive amounts of braking. The aircraft is at its

best when flying below 10,000ft; tactics are more important than brute power maneuvers. In air combat, the Harrier pilot can use the vectored nozzles to out-maneuver a conventional fighter. The following techniques may be worth trying:

1. By lowering the nozzles, the pilot can increase the turn rate of his aircraft, trading speed for turn rate.
2. If the Harrier is being pursued by an enemy fighter, moving the nozzles to 100 degrees will sharply reduce forward speed, forcing a pursuer to overshoot, perhaps to the point where he becomes the pursued.
8. Lowering the nozzles at the top of a loop will pitch the aircraft quickly into a dive, allowing the pilot to quickly line up his gun or missile.
4. Set to 100 degrees or more, the nozzles can act as a brake, allowing the aircraft to dive steeply without a rapid build-up of speed.
5. If a fast dive is needed, this can be done at full power. Instead of reducing power for the pull-out, the pilot can lower the nozzles, turn at the maximum G possible, yet still have full power available after the pullout to ensure fast acceleration.

PRE-FLIGHT CUSTOMIZATION

The first time you enter the cockpit in a game-playing session, you may wish to customise some of the features of this simulation. Pressing ESC will open a menu with the following options:

Controls

Aboard Tarawa, the game can be controlled by the keyboard, mouse, or joystick, but in the air only one method of command can be active. The options for aircraft control are - Joystick, Mouse, or Keyboard. Selecting Joystick will open a further menu offering Calibrate, and Save as Default.

After selecting calibrate, move the joystick to each of its four corners in turn. Once you've done that, press either button to end the calibration process. To make a permanent record of this calibration which will

automatically load every time you start the game, around its limits, press ESC to re-open the control menu, then select Joystick, and Save as Default. The joystick can be recalibrated at any time by pressing the Z key, moving the stick around its limits and pressing either of its keys.

Display

If you find that the game does not run smoothly, the two options offered in this menu will help reduce the demands it is making on your computer. As its name suggests, cancelling the Horizon Shading option will remove the simulated atmospheric effects which reduce visibility near the horizon. Selecting Fast Cockpit Draw will replace the normal cockpit display with an alternative version which presents the same displays and information in slightly simpler form.

Simulation

The default conditions here are for the effects of G Grey Out to be simulated, and for the game to use the Advanced flight model. The latter menu item is also controlled by the Ctrl-S and Ctrl-A keys.

Sounds

Default is All sounds, but you can opt to remove the Engine Noise, while retaining the others.

Commander

This option returns you to the Command Center on Tarawa.

Exit to DOS

This allows you to end the game session. Repeatedly pressing ESC from any point in the game will eventually allow you to exit to DOS.

The choices you make will remain in effect for the rest of the current game-playing session. If you want to make these changes permanent, a similar menu can be found in the Save/Restore game screen. This will

save the changes to the hard disk, so that they can be automatically loaded each time you play the game.

PRE-FLIGHT OPERATING PROCEDURE

Details of missions to be flown are given during briefing sessions in the Pilot's Briefing Room.

Central item in this compartment is a large whiteboard used to display information to pilots. On either side are monitor screens which are used to call up further information. Clicking on these selects the type of data displayed on the whiteboard.

When you enter the room from the corridor or directly from the Command Center, the whiteboard will show the new missions waiting to be flown. If you want to see this at any other time, click on the right-hand monitor screen.

The currently available missions are shown on the whiteboard in two-line summary form:

< mission type>

Primary Target <type> at <name>

Forexample,

CLOSE AIR SUPPORT

Primary Target fuel dumps at DILI

As an AV-8B pilot, you can be tasked with five types of mission during Operation Ocean Saber.

Combat Air Control

Objective: To fly top cover for the fleet or ground forces, engaging any destroying any Indonesian aircraft found the in air. At least one Harrier will always be available to fly CAP missions.

Way points: No way points will be programmed into the aircraft's Nav system.

Default weapons: Sidewinder; cannon.

Reconnaissance

Objective: To observe the battle area, and to relay intelligence back to TAWADS in order to provide a more complete tactical picture of the current state of the campaign.

Way points: Automatically programmed into the aircraft's Nav system using TAWADS data.

Default weapons: ALQ-164 jamming pod (Its electronic systems will observe and record Indonesian radar and radio signals); cannon.

Close Air Support

Objective: To provide fire support for US forces in direct conflict with Indonesian units. Some targets will be laser designated by the ground forces, allowing pilot to use Maverick missiles and laser-guided bombs.

Way points: Automatically programmed into the aircraft's Nav system. Targets will be described in the mission briefing, and TAWADS will automatically set way points over the targets to be attacked.

Default weapons: Laser guided bombs; Maverick; cannon.

Interdiction

Objective: The destruction of one or more targets well behind enemy lines. Targets will not be laser designated, so must be attacked using unguided bombs and rockets.

Way points: Automatically programmed into the aircraft's Nav system.

Turrets will be described in the mission briefing, and TAWADS will automatically set way points over the targets to be attacked.

Default weapons: Unguided rockets; unguided bombs; Sidewinder; cannon.

Air interception

Objective: Engage and destroy enemy aircraft.

Way points: Automatically programmed into the aircraft's Nav system by TAWADS. Way points will be placed at last known location of enemy planes.

Default weapons: Sidewinder; cannon; countermeasures.

To start on of the missions waiting to be flown, click on that mission on the whiteboard. If you don't accept one of the waiting missions, the computer will assign a computer-controlled AV-8B to fly that sortie.

Clicking on an available mission will display on the whiteboard a full briefing for that mission. This will list the primary target, any secondary target, and the programmed way points for both. An Intelligence briefing will also be given, listing the anti-aircraft ground defences at these targets, and the risk to being intercepted by enemy fighters.

The aircraft's Nav system has pre-set uses for several way points.

T The TACAN radio-navigation beacon on Tarawa.

0 Any target of opportunity marked by the pilot during the flight.

From: Squadron Commander VMA-513

To: All pilots

Subject: Nav way points

Before leaving the briefing room to begin a mission, take care to note the identity of every way point programmed into your aircraft's Nav system. Once over East Timor, you'll be busy enough without the added workload of trying to remember the purpose of each way point. I know you guys are keen to be heroes, but time

moves fast when you're flying at low level at a speed of more than 500 kts. Time wasted struggling with way point selection is time in which a fighter, SAM or AAA battery can get a shot at you.

Accepting the mission will take you to the Weapons Loading Screen to select the weapons you want to carry, then into the cockpit ready for take off.

If you want to take over a mission currently being flown by the computer, click on the left-hand monitor to bring up on the whiteboard a list of currently-airborne AV-8Bs. Clicking on any one of these will put you into the cockpit of that aircraft. Turn off its autopilot, and you can fly the mission.

Always remember that after a few hours of operating experience, you'll be a better pilot than the computer. If several missions are being flown, the most effective tactic is to let the computer fly them all, while you use TAWADS to monitor their progress. As each aircraft approaches its target, jump into the cockpit, switch off the autopilot, and fly the attack manually. Once the target has been knocked out, re-engage the autopilot, and let the computer fly the aircraft to its next way point while you jump back to the Command Center and the TAWADS display. This technique will give you the most interesting part of the mission to fly, and leave the autopilot to handle the routine parts of the sortie.

ARMING THE AIRCRAFT

Once you've accepted a mission, go to the flight deck, where the armorers are waiting to load weapons on your aircraft. The aircraft arrives from the hanger with all its pylons empty. A series of buttons at the foot of the screen allows the individual types of weapon to be selected.

There are two ways of loading your weapons. One is to leave the job to the armorers, who'll already have loaded the pylons with what they consider to be a suitable warload for the mission you're about to fly. Details of this combination will have been given during the pre-flight briefing in the Pilots Briefing Room.

If you don't like their selection, you can remove it by clicking on

CLEAN, or modify it by removing the weapons you don't want and installing your own choice. If you've previously flown a mission, clicking on LAST will order the armorers to repeat the loading you specified for that mission.

To install a weapon of your own choice, first select it by clicking on its button. It will appear in the window at the foot of the screen. To load this weapon onto the aircraft, click below the pylon you want to mount it on using the left mouse (SPACE). The chosen weapon should then appear on the pylon. To remove an installed weapon, click with the right mouse button. (ENTER).

As you load weapons, an information line half-way down the screen will show the weight of the weapon currently selected for loading, and the take-off weight of the aircraft with the current warload. If you plan to take-off vertically, the latter figure must be kept below the maximum engine thrust!

The outboard pylons (the one nearest the wingtip) on each side can only carry a small load, but those inboard are closer to the wing root, so can carry a greater load without straining the aircraft structure. If the weapon won't install on the pylon you chose, try one further inboard.

In some cases, several weapons of the same type can be carried on a single pylon using a multiple ejection rack (MER). If another weapon can be carried without exceeding the pylon's load carrying capability, clicking on the pylon a second time will install a second weapon. In some cases, clicking a third time may install a third weapon. The limits on pylon loading can be found by experimenting. The 25mm cannon is always carried under the fuselage.

If you're going to fly a reconnaissance or strike mission, and enemy fighters are expected, you might want to carry an AIM-9M Sidewinder on each outboard pylon. This reduces the number of pylons available for air-to-ground weaponry, but increases your chances of shooting down any fighter which attacks you.

Carrying an ALQ-164 jamming pod will reduce the range at which enemy radars will detect your aircraft. This will make it difficult - but

not impossible - for SAM batteries to launch radar-guided missiles at your aircraft. Carrying a jamming pod reduces your chances of being shot down by a radar-guided missile, but takes up a valuable pylon, reducing the weapon load you can carry.

Within the fuselage of the aircraft are dispensers for chaff and flares. These are released by pressing the C or F key. The numbers remaining for use are shown on the weapons display on the right-hand MFD.

When released, a chaff cartridge bursts to release a cloud of fine strands of metalized glass fiber. These form a radar-reflective false target which can confuse a hostile radar. If attempting to lock onto you aircraft, the radar may instead lock onto the chaff cloud. If already locked on, it may "break lock", following the slow moving chaff cloud rather than the fast-moving aircraft. If a radar-guided SAM has been fired at your aircraft, dropping a chaff cartridge will offer it an alternative target.

Jamming pods and chaff have no effect on anti-aircraft guns, shoulder-fired heat-seeking SAMs or on the less efficient optical back-up guidance modes available of the SA-3 and SA-6 SAM systems. If a heat-seeking SAM or Sidewinder is headed for your aircraft, release a flare. Missiles of this type home onto heat radiated by your aircraft. Flares are fast-burning devices which offer the missile an intense heat source which may distract it from your aircraft.

When attempting to distract an incoming missile, it may not be enough just to release chaff or a flare. For a start, timing is critical. Release the chaff or flares too soon, and the missile will re-acquire you; release them too late, and the weapon will reach your aircraft before being significantly decoyed.

Pulling a sharp turn in the direction of the attack will help break the missile's lock. Never turn away from the missile - this gives it a simple "tail-chase" flight path and an easy kill. Turning toward the missile forces it to maneuver hard in order to follow you,

If you run out of chaff or flares, a sharp turn might still save you. Once again, timing is critical. The closer you let the missile approach before making the turn, the harder it must maneuver to compensate for your sharp change of course. The missile does not have unlimited

maneuvering power, so what you're trying to do is to get out of its way so rapidly that it can't follow. If tasked with attacking a heavily-defended target, you might want to carry an external chaff/flare dispenser on one of your pylons.

While the armorers were loading and fuzing your chosen weapons, other members of the flight deck crew were busy fuelling your aircraft, mid recharging its oxygen system. To begin the mission, click on the OK button. This will put you in the cockpit, and start the aircraft's engine.

SELECTING AND USING WEAPONS

Once airborne and on the way to the first way point, it's time to select weapons. Pressing BACKSPACE cycles through the weapons available. The Stores Display on one of your MFDs will show the selected pylons, and the numbers of weapons on each.

You can only select weapon types, not individual pylons. Bombs or unguided rockets can be released individually, or in a salvo. Pressing the N key will change the salvo size. Guided missiles cannot be salvoed; only one missile will be released for each press of the firing button. Alphanumerics at the bottom left of the HUD will show the type of weapon selected, and the number to be released in the salvo. This information is duplicated on the MFD Stores Display, and on cockpit indicators mounted above the left-hand MFD.

During the pilot's briefing, you'll sometimes be warned that fighters are expected. On the way to and from the target area, choosing GUN or AIM-9M will ensure that you're ready to fight back if enemy F-16s or K-5s try to intercept you.

Use the fire button or SPACE to release weapons. When a multi-round salvo has been selected, a single press will release all the weapons in that salvo. Rockets fire with an interval of 0.2 seconds between rounds, bombs at 0.4 second intervals. After releasing weapons, the fire button/SPACE control is inactive for 0.5 second, 0.1 second in the case of the cannon.

Cannon

The aircraft's 25mm cannon is aimed using the velocity vector marker in the HUD. The gun has 300 rounds of ammunition, and the number remaining is shown in the Stores Display screen on the MFD display.

Iron Bombs & Rockeye

Free-falling bombs can be delivered on one of two modes - CCIP and automatic. Both are available in this simulation.

CCIP Mode

Normal method of aiming iron bombs is by means of the Continuously Computed Impact Point (CCIP) mode. As its name suggests, during a CCIP attack, the aircraft's Nav system is continuously computing the point where the bombs would land if released now, and marks this in the HUD with a small cross-shaped aiming mark. A line is automatically drawn between this CCIP marker and the LFD. Known as the CCIP line, this is used when delivering bombs in Automatic Bombing mode, or when aiming laser-guided bombs (LGBs).

When dive bombing, the CCIP marker will be easily visible in the HUD field of view. If you fly a horizontal attack at low level, you'll have to fly fast to keep the CCIP marker in the HUD field of view. In practice, AV-8B pilots normally keep the speed to 450 kts. or more when making CCIP attacks from low level.

Automatic Bombing Mode

To toggle between CCIP mode and the alternative Automatic Bombing mode, press the ' (single quote) key.

Once the target is visible in the HUD, place the LFD aiming mark over it and press ENTER or the second mouse or joystick key. This locks the nose-mounted ARBS video camera onto the selected spot on the ground, designates this as way point 0, and selects way point zero. Remember that the ARBS isn't locked on to the target, but is tracking a designated point on the ground. If that point wasn't lined up with the target, the automatic system has no way of compensating for this.

The aiming point will be marked by a cross on the ARBS video display, and a cross in the HUD. Position the CCIP line over the target, and hold it there. Press and hold down the fire button to indicate to the automatic bombing system that it is free to release ordnance. If you keep the CCIP line on the target, and the fire button pressed down, the bombs will be released automatically. If no bombs are released, the CCIP line was not aligned accurately with the target - the Automatic bombing mode won't release weapons which have no chance of hitting the designated aiming point.

Unguided Rockets

Rockets are launched in CCIP mode. In this case the HUD does not show a CCIP line - only a "T"-shaped CCIP aiming mark.

AGM-65E Maverick

Maverick is designed to home onto targets which have been laser-designated by friendly forces. If Maverick is selected, and a target is being designated by ground forces, a square marker will appear in the HUD as you approach the target area. Maverick can then be fired and will home automatically without further action by the pilot.

Firing a Maverick — or any other guided weapon — does not automatically result in a "kill". For a start, you may have fired at too great a range. Also be aware that missile homing systems are not perfect, but should bring a missile within several feet of its target. During trials in the late 1970s, half the Maverick rounds fired landed within four feet of the target. The others exhibited greater errors, in some cases 10 feet or more. All guided missiles exhibit such variations in accuracy between individual rounds, and in some cases may not land close enough to score a "kill". In AV-8B Harrier Assault, missile behaviour has been accurately modelled to reflect such small errors. If firing a guided missile doesn't result in a kill, the simulation is not at fault. Make a second pass, and fire another weapon at the target.

Laser-Guided Bombs (LGBs)

Like Maverick, LGBs are laser-homing weapons which require their target to be designated. Operating procedure is similar to that for

Maverick, but these unpowered weapons have less range and maneuvering capability than the AGM-65. LGBs must be dropped close enough to the target to allow their limited maneuvering power to successfully guide the weapon to a "kill". It is essential that the CCIP line be positioned inside the square marker when the bomb is released

A1M-9 Sidewinder

Selecting AIM-9 will automatically activate the IR seeker of the Sidewinder missile. This will scan an area ahead of the aircraft, looking for a suitable target. Any target aircraft visible through the HUD will be in the Sidewinder's field of view, and the missile will lock on automatically. If several aircraft are visible within the HUD, Sidewinder will lock onto the nearest.

You will receive two indications of successful lock-on. A circular mark in the HUD will track the target, and you will hear a "growling" tone generated by the missile seeker head. The missile can then be fired, and will home automatically. If the seeker has not locked onto a target, the missile can still be launched, but it will not home.

AIM-9M will not home onto Indonesian C-130 Hercules transports. Use the cannon to attack these.

AGM-88 HARM

If you wish to attack a radar-guided SAM site, turn your aircraft onto the threat bearing indicated by the radar-warning receiver. Once the radar is within the HUD field of view, a square aiming mark will become visible. This will track the target, indicating that the missile has locked on.

Firing at too great a range can fail to generate a "kill", either because the missile did not have enough range to reach the target, or because the radar has been switched off. (The latter tactic is a good counter to HARM, since it deprives the missile of its ability to make further course corrections.) Launching the missile at closer range will reduce the enemy's chances of switching off in time, but if misjudged could give him the chance to fire a SAM at your aircraft.

POST-FLIGHT DEBRIEFING

On landing from a successful mission, waiting a short time or pressing Ctrl-D will bring you back to the Pilots Briefing Room. De-briefing information will be displayed on the whiteboard. Once you've read this, clicking on the right or left monitors will bring up a listing of the missions waiting to be flown, or those currently under way.

ALTERNATIVE LANDING SITES

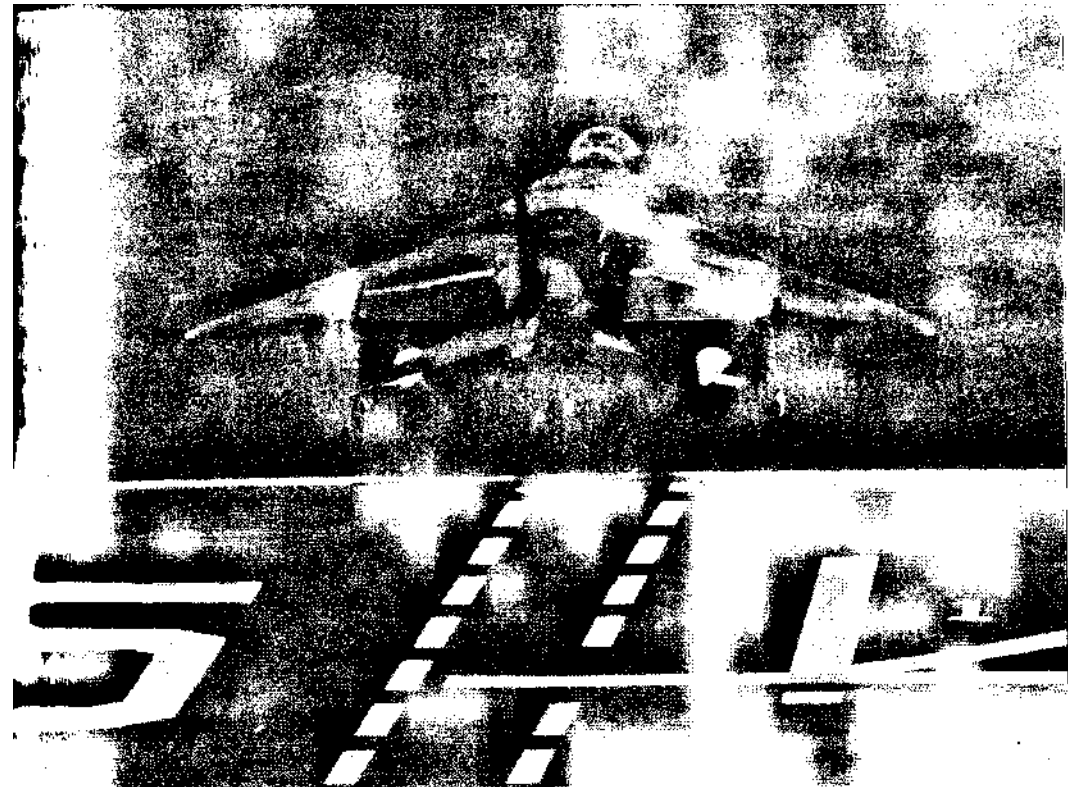
Undernormal circumstances, you will always land back on Tarawa. Although some of the other assault ships are carrying spare AV-8Bs and can ferry them over to Tarawa to replace aircraft lost in combat, the aircraft were loaded onto these ships by crane. You cannot land on vessels other than Tarawa.

If you run short of fuel when flying over East Timor, you may land at any airfield which has been captured by the Marines. They will almost certainly find enough Indonesian fuel to refill your tanks, and may even have some 25mm ammunition available to reload your cannon.



**SECTION
V**

**SHIPS AND MEN OF
THE TASK FORCE**



THE SHIPS AND MEN OF THE TASK FORCE

Tarawa: Lead Vessel of the Assault Force

The most important vessel in the fleet under your command is the assault ship LHA 1 Tarawa. Built in the early 1970s, this was the first of a class of five vessels intended to combine the functions of the earlier Iwo Jima-class helicopter carrier (LH), with those of a dock landing ship (LPD) and an assault cargo ship (LKA).

Tarawa was built by Ingalls Shipbuilding Corporation. She was laid down 15th November 1971, launched on 1st December 1973, and commissioned on 29 May 1976. She was followed by five sister ships, the Saipan, Belleau Wood, Nassau, and Peleliu. A total of nine had been planned when the class was trimmed to only six in 1971 even before Tarawa had been laid down. All six ships were built by Ingalls, with the last example entering service in 1980.

Tarawa and her sister ships are the world's largest amphibious vessels. To the layman, Tarawa looks like an aircraft carrier. Similar in size to a Second World War Essex-class aircraft carrier, the ship is 834 feet long, 132ft wide, and has a full load displacement of 39,967 tons. Impressive though these figures are, Tarawa is some 200ft shorter than a modern aircraft carrier, has about half the displacement, and lacks the angled flight deck, aircraft catapults, and arrestor gear needed to operate conventional jet fighters.

Tarawa is designed not to provide the large-scale air power available from an aircraft carrier, but to embark a Marine amphibious unit, transport it over long distances, deploy it ashore, then loiter in the area to support it. This ability to land forces on a distant shore is one component of the mobile force structure which makes the United States a superpower. Nations such as China may have strategic nuclear weapons, but lack this ability to intervene at trouble spots around the globe. The Commonwealth of Independent States which resulted from the break-up of the Soviet Union would have difficulty in carrying out this sort of force projection.

Tarawa has enough accommodation space below decks for a reinforced battalion - a total of around 2,000 men, plus the hardware needed to give them firepower once ashore - five M60 tanks and six 105mm field howitzers. Although powerfully armed, it's a numerically small force, one better suited to a swift "surgical" strike rather than long slogging match against enemy forces operating at brigade strength (around 5,000 - 8,000 men) or divisional level (around 15,000 - 20,000 men.)

On land, armies can request supplies, firepower, or even diversionary attacks from other units along the same front line. There is no such tactical luxury for Marine units sent onto a hostile shore. Every bullet and Band-Aid they need, they must take with them. Trained to fight under such self-sufficient conditions, the Marines regard themselves as an elite unit, perhaps the elite unit. A US Marine may grudgingly accept that the British SAS, the Russian Spetsnaz, the Israeli paratroopers, and the French Foreign Legion are tough, but this won't dent his conviction that the Marines are the toughest soldiers who walk this planet.

Tarawa's 820ft X 118ft flight deck can handle twelve CH-46 Sea Knight assault helicopters, or nine of the heavier CH-53 Sea Stallion. Directly below the flight deck are two half-length hanger decks. These can house up to 26 CH-46 or 19 CH-53. These aircraft can be moved to and from the flight deck via one elevator mid-way down the port side of the ship, and a second rear the stern. AV-8B Harriers are carried as required for the individual mission.

For Operation Ocean Saber, Tarawa carries eight AV-8B, plus 28 helicopters. A separate vehicle deck carries the wheeled and tracked vehicles for the vessel's force of Marines. The vessel is operated by a crew of around 900, bringing the total to around 2,900.

In the lower part of the aft section of the vessel is a feature unique to amphibious assault ships - a large docking well. This can be flooded to allow landing craft to enter and leave via a stern-mounted door which gives access to the sea. On Tarawa, the well is 286ft long and 78ft wide, HO can accommodate a wide range of landing craft. For this mission, it contains four LCU, and two LCM-6. Forty LVT tracked landing craft are carried on a separate vehicle deck.

Built in large numbers between the mid-1950s until the mid-1970s, the LCU (Landing Craft Utility) is the descendant of the Second World War LCT (Landing Craft Tank). Maximum payload of these 135 foot long vessels is 180 tons. For example, they can carry three tanks. Later models have bow and stern ramps, to enable vehicles to drive through. LCUs are powered by four diesel engines, and have a top speed of 20 kts.

The 56 foot long LCM-6 was a Second World War design, but remained in production until the 1970s. It can carry 80 soldiers or 34 tons of cargo. Two diesel engines give a top speed of 20 kts.

One of the most tactically useful vehicles in the early stages of an assault is the LVTP-7 Amphibious Assault Vehicle. (In the game, these are referred to simply as LVTs) As its full designation "Landing Vehicle Tracked Personnel" suggests, this is a vehicle able to propel itself in the water, climb a beach under the power of tracks, then carry its soldiers inland.

The LVT weighs around 50,000 lbs., and can carry 25 Marines, who enter and leave the vehicle via a rear-mounted ramp. Hatches in the upper surface allow cargo to be loaded from above, either when the vehicle is aboard ship or floating alongside a ship. A Cummins VT8 diesel engine drives the vehicle at speeds of up to 39mph, while in the water, two water jets propel it at speeds of up to 8.5mph.

It takes primitive terrain to top an LVT. The vehicle can cross an 8 ft. wide trench, climb over a 3 ft. obstacle, and has a ground pressure of only 8 lbs./sq in. The hull is made from aluminum armor between 0.27 - 1.77 inches thick, and the vehicle has a turret armed with an M85 0.5" caliber machine gun.

More than 33,000 square feet of storage space is available aboard Tarawa for vehicles, plus almost 117,999 cubic feet of space for palletised stores. To support the landed force of close to 2,000 Marines requires several hundred tons of stores, so the ship has built-in automated cargo-handling facilities include conveyors and elevators. These can handle up to 240 one-ton pallets per hour.

A massive conveyor system runs along the top of a central support structure which divides the docking well in two, then forward onto the

vehicle deck. Five elevators - two in the well deck area, and three at the front end of the conveyor - lift the cargo pallets from the cargo holds deep in the ship, allowing them to move rearward to the well deck, where an overhead monorail system loads them onto the landing craft. The aft pair of transporters can also be used to move pallets to the hanger deck, while an inclined ramp allows pallets to be moved up to the flight deck for loading onto helicopters.

To be effective, Tarawa's Marines must be able to perform at peak efficiency as soon as they go ashore. To help prepare the Marines to cope with the climate they will experience at their destination, a 5,000 squarefoot training and acclimatisation room is available. (In this game, the acclimatisation room also contains the Part Task Trainers which will help teach you how to fly the AV-8B.) Other facilities include a hospital able to provide intensive care for up to 90 casualties.

Command facilities are located in the massive island superstructure at the starboard side of the flight deck. From here the commander of the amphibious task group and the landing force commander issue their instructions via the Tactical Amphibious Warfare Data System (TAWADS) - a computer-controlled system able to store information on targets, and keep track of landing craft, helicopters, vehicles, soldiers, and cargo. Later in this manual, you'll learn how to use TAWADS to generate battle plans, and to control the amphibious assault forces and the AV-8B Harriers.

In an era when most major US warships are driven by gas turbines or nuclear power, the Tarawa class relies on a traditional steam powerplant. Two Combustion Engineering boilers provide the steam needed to drive two Westinghouse geared turbines, each of which powers one of the vessel's two propeller shafts. The turbines deliver a total of 70,000 shaft horse power, enough to take Tarawa to a top speed of 24 kts. Maximum range at a more economical cruising speed of 20 kts. is 10,000nm.

The Navy has only two Blue Ridge class command ships, so may not be in the area of an amphibious operation. To get around this problem, the Tarawa class are equipped with extensive command and control facilities, including an SPS-52B radar for fighter control.

During an amphibious operation, Tarawa and her sister ships would be obvious targets for enemy attack. Three types of weapon are carried for self-protection. A single Mk45 75mm/54 gun is mounted at the port and starboard front corners of the flight deck, a third at the starboard rear. These can fire 20 rounds per minute. Maximum range is 8nm in the anti-aircraft role, 12.4nm against land targets.

When the vessels first entered service, the port rear corner carried an eight-barrelled launcher for the Sea Sparrow surface-to-air missile, while a second was positioned forward of the island. The final self-defense weapons were six single-barrelled Mk67 20mm cannon.

In the 1980s, a retrofit program installed two General Dynamics Mk15/16 Phalanx 20mm close-in weapon systems (CIWS) on each ship. These were mounted in the positions formerly used by Sea Sparrow. The 20mm Mk87 gave way to six 25mm Mk 242 cannons.

Phalanx is intended to protect the ship against anti-ship missiles which make it part of the surface-to-air missile firepower of the fleet's warships. This is a "last-ditch" weapon - a radar-controlled automatic gun mount whose six-barrelled Gatling gun pours out 50 20mm caliber cannon shells per second. Maximum range is short - if an enemy missile is closing for the kill, Phalanx will have only a few seconds to score a kill.

The cannon shells do not carry an explosive payload; damaging a missile at such short range would probably not stop the crippled round striking the ship. The projectiles leaving the Phalanx gun barrels are solid, and made from depleted uranium, one of the heaviest metals known to man. If hits are obtained on the missile, the impact energy of these heavy high-speed projectiles should be enough either to cause massive structural damage which will knock the weapon off course, or even to detonate the missile's warhead.

Tarawa also carries extensive electronic warfare (EW) protection, including the SLQ-32(V)3 system. This is designed to detect and jam hostile radar signals. Four six-barrelled SRBOC launchers are available to release chaff and IR decoys in further attempts to confuse incoming anti-ship missiles.

More Ships and More Men

On its own, Tarawa could not carry a large enough force of Marines to carry out Operation Ocean Saber. Supporting her are six other amphibious-warfare vessels, an escort of four warships, and a tanker.

To provide additional amphibious capability, the fleet includes five Dock Landing Ships. Like Tarawa, these slightly smaller vessels carry Marines and their equipment, and incorporate docking wells designed to handle landing craft. Newest of the five is LSD-41 Whidbey Island, first of a class of eight modern dock landing ships built to replace the older Thomaston class, this was built in the early 1980s by LockheedSeattle. Whidbey Island is 609ft long, and has a full load displacement of 15,725 tons. It carries a force of 500 Marines plus their equipment. Its 440ft X 50ft well deck houses four LCAC air-cushion landing vehicles.

Gradually replacing the older LCU, are the LCAC (Landing Craft Air Cushion). These can carry only 24 soldiers, a single tank, or between 60 and 75 tons of cargo, but have a top speed of 40 kts. when fully loaded. Their great advantage, apart from high speed, is that they can land on most shorelines. Conventional landing craft require careful choice of landing site. According to the US Navy, the LCAC can cope with around 70 per cent of the shorelines around the world, while the LCU was restricted to around 15 per cent. Apart from their smaller payload, CVACs have some disadvantages compared with LCUs. They are noisy, create clouds of spray (which sometimes interfered with the driver's vision before the addition of spray suppressers), and can have problems in rough seas.

Whidbey Island also has up to 5,000 cubic feet of space available for marine cargo, and 12,500 square feet for vehicles. Four Colt/Pielstick diesel engines driving two shafts give a total of 41,600shp and a top speed of 22 kts.

The rest of the Marine Expeditionary Brigade is deployed on LPD-4 Austin, LPD-5 Ogden, LPD-7 Cleveland and LPD-9 Denver. These are 570 feet long, with a 16,900 ton full load displacement. Part of a class of 12 vessels built in the 1960s, each can each carry 1,000 Marines and 2,500 tons of cargo. The 168ft X 50ft well deck can house one LCU and three LCM-6. These landing craft can be supplemented by several more

carried on deck and lowered into the sea by an aft-mounted crane. Austin lacks the helicopter hanger added to later vessels of the class. As a result, only Ogden, Cleveland, and Denver can carry aircraft. Typical loads might be one SH-60, two CH-46, or four AH-1W. Being almost 30 years old, Austin and her sister ships are steam-powered. Both have twin-shaft installations delivering around 24,000shp and giving a top speed of around 20 kts.

For self-protection, all five Dock Landing Ships are fitted with the SLQ-32(V)1, a simpler version of the EW system carried by Tarawa. All five also have four SRBOC chaff/flare launchers, while Whidbey Island also has a pair of 20mm Phalanx guns.

Cargo and Fuel

To carry the rest of the Marine Expeditionary Brigade's heavy loads, the force includes the Vehicle Cargo Ship T-AK 3009 Pfc Dewayne T. Williams. Built by General Dynamics, this 44,330 ton vessel joined the fleet in 1985 on long-term charter. The ship is operated by American Overseas Marine, and has a crew of 30, plus 25 technicians. On its own it can carry 22,700 tons of equipment and supplies, 25 per cent of the stores needed by a Marine Expeditionary Brigade over a 30 day period. It has a roll-on/roll-off capacity of more than 150,000 square feet, and can carry 530 cargo containers. It also delivers vehicle and aviation fuel.

Unlike the Whidbey Island and the Austin class, Pfc Dewayne T. Williams is not an amphibious ship. It unloads its cargo either by using port facilities, or at sea by means of its built-in cargo-handling equipment. This includes two twin cranes and one single crane. A small landing platform for helicopters is located at the rear of the superstructure. The vessel is powered by two Stork Werkspoor 16 TM 410 diesel engines, and has a speed of 18 kts. Maximum range at this speed is 12,840 miles.

The Warship Escort

Keeping this assault force safe from land and sea attack is the task of the warships assigned to escort the formation. During the Second World War, an amphibious task force would have been escorted by heavy cruisers or even one or more battleships, but these massive gun platforms have been retired.

For this mission, the use of guided-missile cruisers has been ruled out by Washington, so the largest and most powerful of the vessels escorting the amphibious force is the 563ft long guided missile destroyer DDG 933 Kidd. Originally laid down in June 1978 for the Imperial Iranian Navy, and named Kouroush, Kidd and her four sister ships were taken over by the US Navy following the Iranian Revolution. Kidd was launched by Litton on 11th August 1979, and was completed in the summer of 1981.

The Kidd class are a specialised anti-aircraft version of the US Navy's Spruance-class destroyer. The equipment fit of the Spruances were trimmed to save money but the Shah of Iran had opted for the original specification. As a result, Kidd and her sister ships are the most powerful destroyers in the US fleet. Full load displacement is 9,200 tons, around 1,400 tons more than a Spruance. This extra weight is partly due to the installation of armor protection, also three additional radars - an SPS-48 and two SPG-51 radars. The Kidd class is ideal for tropical service, since its air-conditioning systems were designed to cope with operations in the Gulf.

The ship is armed with missiles and guns. Two Mk 45 5 inch guns mounted forward and aft have a rate of fire of 20 rounds per minute. Maximum range is 12.6nm against surface targets. Inboard of the guns are two Mk 26 twin-rail missile launchers able to fire SM-2MR Standard SAMs or ASROC anti-submarine missiles. Maximum range of this version of Standard is 40nm. Two eight-round launchers for Harpoon missiles allow ship targets to be engaged at ranges of up to 70nm. The hanger carries either two SH-2F helicopters, or a single SH-60. Two 20mm Phalanx guns are carried for point defense.

Like Tarawa and the Dock Landing Ships, Kidd is equipped with an electronic-warfare suite, plus four SRBOC launchers for chaff and flares. In this case EW system is an SLQ-32(V)2 updated by the

Sidekick program to add jamming and deception modes. During the late 1980s, Kidd and her sister ships were updated under the US Navy's New Threat Upgrade (NTU) program to improve their ability to deal with sophisticated aircraft and missile threats.

The ship is powered by four General Electric LM2500 gas turbines. These develop a total of 80,000shp, and drive two shafts, giving the ship a top speed of 30 kts. Range at 20 kts. cruising speed is 6,000nm.

The other three escorts are smaller and less well-armed vessels — 445 ft. long frigates of the Oliver Hazard Perry class. Built in the late 1970s, FFG-10 Duncan, FFG-11 Clark and FFG-20 Antrim joined the fleet in 1980-81. Displacing around 3,500 tons at full load, the Perry class were designed as a lower-cost alternative to the Spruance-class destroyers. To keep costs down, these vessels are armed with only a single Mk13 trainable missile launcher, plus a 3inch Mk 75 gun.

Two General Electric L2500 gas turbines drive a single shaft (another cost-cutting compromise), and deliver a total of 40,000shp. This gives a top speed of 28.5 kts. Maximum range at 20 kts. is 4,500nm. Normal crew complement is 206, including 13 officers and 19 aircrew.

The Mk13 missile launcher is the vessel's primary armament. It can fire Standard SM01MR anti-aircraft missiles, or Harpoon anti-ship missiles. This version of Standard has a range of only 25nm, much less than the 40nm of Kidd's SM-2MR missiles. The vessel is also fitted with two triple launchers for anti-submarine torpedoes, and carries two SH-2F or two SH-60 helicopters.

The 3in gun can fire 85 rounds per minute. Maximum range is 8.7nm against surface targets, or 6.6nm against air threats. A single 20mm Phalanx is mounted on the roof of the aircraft hanger. Electronic-warfare and chaff/decoy facilities are similar to those of Kidd.

To support the Tarawa, her five supporting ships, and the warship escort, the fleet is accompanied by the 41,350 ton Replenishment Oiler AOR 6 Kalamazoo. Built by General Dynamics, and commissioned in 1973, Kalamazoo is one of a class of seven ships designed to support naval units operating at sea. It can carry 160,000 barrels of fuel, 600 tons of munitions, 200 tons of dry stores, and 100 tons of refrigerated stores. Cargo-handling is highly automated. Powered by

General Electric steam turbines, the ship has a top speed of 20 kts. Maximum range is 6,500 miles at 19 kts., or 10,000 at 16 kts. Normal crew is 454.

A ship with this capability needs to be able to defend itself, so Kalamazoo carries a single Mk 29 eight-barrelled launcher for Sea Sparrow surface-to-air missiles. Like Tarawa, it is fitted with the SLQ-32(V)3 electronic-warfare system, plus four six-barrelled SRBOC launchers for chaff and decoy flares. Add-on armament can include two 20mm Phalanx CIWS, or four 20mm Oerlikon cannons. Kalamazoo has a small flight deck and hanger. These were designed to handle two UH-46 helicopters.

The Marine Expeditionary Brigade

The force tasked with Operation Ocean Saber is a Marine Expeditionary Brigade (MEB) whose Regimental Landing Team will carry out the landing and ground combat. An MEB is commanded by a Brigadier General, and built around a reinforced infantry regiment and a composite Marine aircraft group. Self-sustainable for up to 30 days, an MEB is used to provide rapid response in what are euphemistically called Low Intensity Conflict situations.

In real life, the Regimental Landing Team is a complex organization, incorporating specialized units such as armour and artillery and supported by a Brigade Service Support Group. To make the game easy to play, we have assumed the landing force consists entirely of normal infantry battalions, and that these incorporate the supporting armour and artillery. The number of infantry battalions has been increased to compensate for the "missing" support units.

A normal Marine regiment consists of three battalions, each with around 1,200-1,400 men. These have a two-digit designation. Our landing force is based on the 9th Marine Regiment, and has three battalions - 1/9, 2/9, and 3/9, plus two battalions from the 6th Marine Regiment - 1/6 and 2/6.

Each battalion has three rifle companies. The first battalion has A, B, & C companies, the 2nd E, F & G, the 3rd I, K, & L.. Company designations D, H, and M are never used. During the last decade,

battalions were slimmed down from four companies to three, eliminating D, H and M, but the remaining three retained their traditional designations. Each company consists of a 1st, 2nd and 3rd platoon.

US military "shorthand" for the A company, 1st battalion, 9th Marine Regiment is "A/1/9", but the unit designations you'll see in the game are written in fuller form, such as "A coy, 1st bn, 9th Marines". The TAWADS tactical map does not identify individual platoons, so don't be surprised to see several units in close proximity all labelled identically. These will be individual platoons of the same company.

The Marines will go ashore either in conventional landing craft or in the amphibious Landing Vehicle Tracked (LTV). They can also be flown into battle aboard CH-53 Super Stallion helicopters. These heavy assault helicopters can carry up to 55 soldiers, or 36,000 lbs. of stores.

Once ashore, the Marines will move inland in their HMMWVs (High Mobility Multipurpose Wheeled Vehicles). Referred to as "Humvees", these jeep-like vehicles can carry six men, or a light weapon such as a 20mm cannon or recoilless rifle.

One thing any amphibious assault force is always short of is armored vehicles. The only main battle tanks available to go ashore are 20 M1 Abrams. These tanks weigh around 60 tons, and are armed with a powerful 105mm gun. The accuracy and armor-piercing capability of this gun far surpasses that of the 100mm gun mounted on Indonesian tanks. The latter have no modern fire-control system; if the first shot misses the target, the crew must try to correct the aim manually. The computerized system on the M1 should near-guarantee that if the first shot misses, the second will score a hit.

The M1 has a top speed of 45mph on a road surface, can cross 9ft trenches, and climb a 4ft obstacle. It has a crew of four, and is protected by composite armor which is much more effective than the steel used in older tanks such as Indonesia's T-59s.

To supplement this small tank force, the Marines have more than 400 eight-wheeled LAV-25 Light Armored Vehicles. The standard version is armed with a 25mm cannon and a co-axial machine gun, but the air-

defence variant has a lighter four-barrelled cannon and four Stinger shoulder-fired anti-aircraft missiles. The LAV has a crew of three, and a top speed of more than 60mph on a good road surface.

Although the AV-8Bs will do their best to provide air support for the Marines, additional air-strike capability is available either from AH-1W Sea Cobra attack helicopters, or from CH-53 rigged with externally-mounted weapon launchers, and cannon or machine gun able to fire through the windows. The AH-1W Sea Cobra is a custom-built attack helicopter with a two-man crew - pilot and gunner - and heavy armor protection. A nose-mounted night-vision FLIR system, allows it to fight by day or night, carrying up to eight TOW or Hellfire antitank missiles, plus AIM-9 Sidewinders for air-to-air combat.

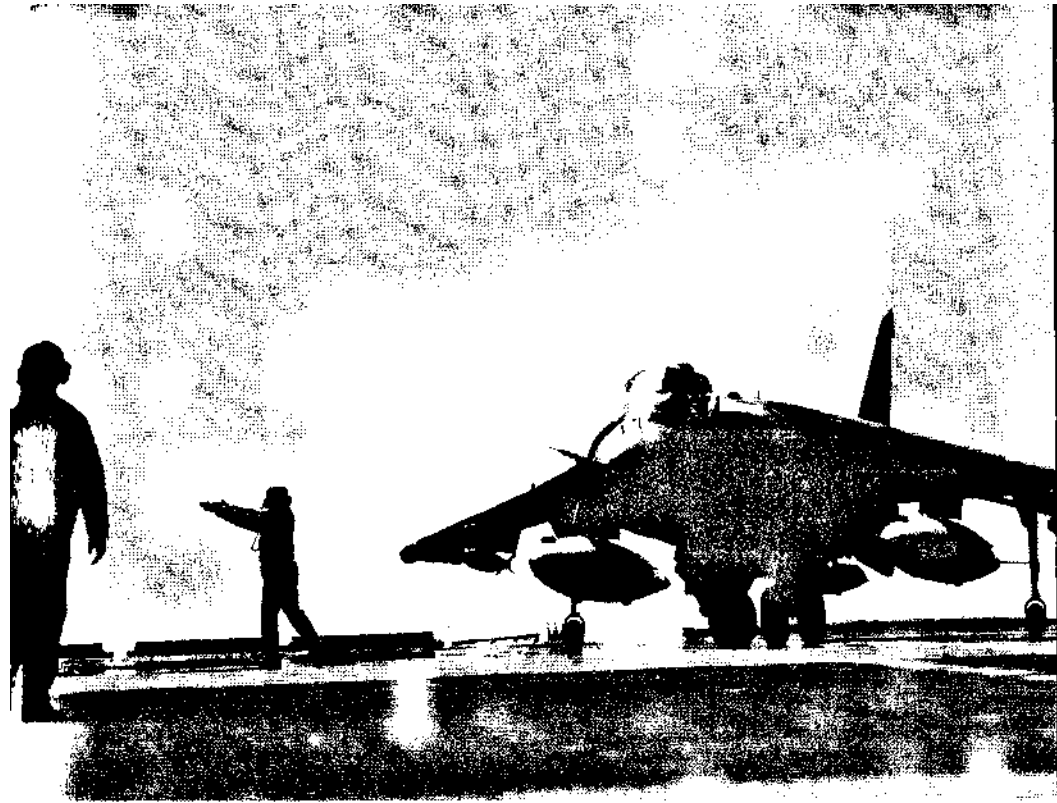
For artillery support, Marine artillery units are equipped with the light but hard-hitting M198 155mm howitzer. This has a maximum range of around 15 miles, and can deliver shells twice the weight of those fired by Indonesia's shorter-ranged artillery. The landing force has 18 six-gun batteries of M198 howitzers.

To deal with enemy tanks, the Marines also have ground-launched TOW anti-tank missiles, plus the smaller shoulder-fired Dragon anti-tank missile. The Stinger shoulder-fired heat-seeking SAM is also available to protect mobile units from attack by Indonesian aircraft.



SECTION
VI

ABOARD THE TARAWA



ABOARD THE TARAWA

After the animated sequence which starts the game, the player will be placed in the command center of the Tarawa. The entire game is controlled from this location, including command of the task force and the despatch of aircraft on combat missions.

From this location, you have four options:

1. Move around the carrier to visit other compartments.
2. Use the Tactical Amphibious Warfare Data System (TAWADS) to plan or change combat operations.
3. Save the current state of the game, or reload a saved game.
4. Pause the game.
5. Quit to DOS.

Below deck, a single corridor gives access to all parts of the ship you'll need to use. To get to it, click on the EXIT sign at the top left-hand corner of the screen. (Similar EXIT signs will be found in all the compartments you visit.)

Along one side of the corridor are the Pilot's Briefing Room, the Command Center, the Acclimatization Room, and the Hanger. From the other side, a passageway leads to the flight deck.

You'll see the corridor from a position about half-way along its length. Clicking on the red-colored arrow marking on the deck will allow you to look in the opposite direction.

To enter one of the compartments, click on its name, or in the case of the flight deck, on the sign "TO THE FLIGHT DECK". Note how the shape of the cursor changes from an arrow to a cross as you align it with the name, sign, or arrow. This change in shape shows that the cursor is aligned with a selectable option.

At either end of the corridor are elevators. These will take you to three other levels of the ship:

PRIMARYFLIGHT CONTROL (PRI-FLY)

COMMANDCENTER (COMM. CNTR)

CARGOHOLD

VEHICLE DECK

Clicking on the appropriate switch will take you the level you've selected.

Clicking on the EXIT sign at the top left of the screen will take you back to the corridor, directly in the case of compartments in the corridor, or via the elevator in the case of the other decks.

Modern warfare is fast-moving, and in the heat of battle, time is short. To help you, "short cuts" are provided to those parts of the ship you'll need to visit most often.

There are telephones in most compartments. Clicking on these will take you immediately to the Command Center.

WHAT THE COMPARTMENTS DO

Each compartment of the ship has its own specialised function:

The Command Center

The Command Center has two large wall-mounted displays, and three computer consoles. As was the case in the corridor, the cursor will change shape from an arrow to a cross to indicate possible selections.

The central computer console in the Command Center gives access to The Tactical Amphibious Warfare Data System (TAWADS), a sophisticated integrated computer system designed to provide command and control over the group's aircraft, weapons, sensors and landing craft.

TAWADS has two main purposes. Before the campaign begins, it is used for detailed strategic and tactical planning. When TAWADS is ordered to run a plan, it will automatically send the relevant orders to the units which are tasked with carrying them out. No military plan

ever survives contact with enemy, but must be modified and updated as the campaign proceeds. TAWADS will allow you to assess the progress of the conflict, and to issue direct orders to ground and air forces, ordering them to carry out specific tactical tasks not envisaged in the original battle plan.

Full information on the use of TAWADS is contained in the Task Force Commander's Manual

Pausing the Game

When the phone rings, or other interruptions disturb the player, it's easy to pause the simulation. Just click on the command center digital clock. (When you're in the cockpit flying a mission, the game can be paused by pressing the P key.)

Saving the Game

The Command Center is the only location where you can save the current state of the game.

As you play through a campaign, the computer keeps track of the current position of the fleet, plus the position of all US and Indonesian ground forces, and what they are currently doing. It also keeps a record of damage which you have inflicted on the enemy's fixed bases, and the losses in aircraft, helicopters, vehicles, and men which you have suffered. Finally, it must also note any changes that you have made to the current battle plan.

Saving a game takes an electronic "snapshot" of all this information and stores it on the hard disk. You can reload this saved game at any time - this will reset the entire game world back to where you were when the save was carried out.

There are at least two reasons for saving a game. After you have been playing for several hours, the Real World may suddenly intrude - the dog demands to be walked, it's time to eat, or time to sleep. It might even be time to use the computer for something so mundane as work. Saving the game before quitting will allow you to continue play at a later date.

The other reason for saving is to preserve a record of your success to date. Saving regularly is an insurance policy against things suddenly going wrong. If you make a tactical error, or the Indonesians hit you with a brilliant counter-attack, you can effectively reset the clock and try a different strategy.

The save/load game screen is called up by clicking on the disk icon on the command center desk (You'll see it to the left of the white telephone). The screen has save/load facilities on the left hand side, and a record of the game-configuration preferences on the right.

There are 10 slots available to hold saved games.

To save a game, click on one of the slots. It will become highlighted.

Click onto the Save Game icon (an arrow pointing at a floppy disk). The current game state will be saved into the hard disk, and the selected slot will now contain the name of your saved state. It should read something like SABER 0/9:50. The name is made up to the name of the plan currently being run, plus the current date and time. The example shown contains Plan SABER at the state it had reached by 9.50am on day 0 of the campaign.

A saved game can be retrieved at any time by entering the SAVE/LOAD screen, clicking on the slot which contains the saved game, then clicking on the Load Game icon (an arrow pointing away from a floppy disk..

The Preferences section of this screen allows you to permanently configure some features of the game. (These can be configured for the current game session only by the means of a menu accessible by pressing ESC while in the AV-8B cockpit.) Each customizable feature has its own icon. Click on these to change a preference - for example, click on Joystick Control to set the default control to joystick. Preferences can be saved by clicking on SAVE PREFERENCES.

Useful Short-Cuts

The Command Center also provides three useful "short-cuts" to other parts of the ship:

This is the only compartment where clicking on the telephone does not take you to the Command Center. When playing the game, you'll often be switching between the Pilots Briefing Room and the Command Center, so clicking on the white telephone in the Command Center takes you directly to the pilots briefing room. If a red light is flashing on this phone, this indicates that fresh missions have been posted on the whiteboard of the Pilots Briefing Room.

Clicking on the left-hand wall-mounted display takes you directly to the aircraft cockpit.

Pilots' Briefing Room

Visit the Pilots' Briefing Room to select the AV-8B missions you want to fly, and to receive pre-flight briefings before take-off. Return there after landing to receive a debriefing report summarizing the success of your attack.

Central item in this compartment is a large whiteboard used to display information to pilots. On either side are monitor screens which are used to call up further information. Clicking on these selects the type of data displayed on the whiteboard.

When you enter the room from the corridor or directly from the Command Center, the whiteboard will show the new missions waiting to be flown. If you want to see this at any other time, click on the right-hand monitor screen. Clicking on the left-hand monitor will bring up on the whiteboard a list of currently-airborne AV-8Bs. Clicking on any one of these will put you into the cockpit of that aircraft. Turn off its autopilot, and you can fly the mission.

Consult the AV-8B Pilot's Manual for full information on how to use these displays.

The AV-8B Cockpit

Once you're in the cockpit and airborne, there are four ways of getting back to the ship:

The most obvious to is complete the mission, then land (either manually or under autopilot control). After landing, pressing Ctrl-D or waiting for a short time will take you back to the Pilots Briefing Room for a debriefing session which will tell you how well the mission went. The only type of mission which does not result in any debrief is a Combat Air Patrol. (Having flown the mission you'll already know how many aircraft you shot down.) If you want to skip the debrief, press Ctrl-C after you land. This will take you directly to the Command Center.

Like all pilots sent to war, you run the risk of being shot down. Using the ejection seat to escape from a crashing AV-8B should see you returned to the Pilots Briefing Room for a debriefing session. Whether you land in the sea or on East Timor, a rescue helicopter will almost certainly get to you, and return you to the ship. Like AV-8Bs, the small force of pilots is a valuable resource.

If you crash, either due to pilot error or by being shot down, you'll be returned to the Command Center - dead pilots don't need debriefing sessions!

If you press ESC, then select Commander from the menu which appears, you go back to the command center, while the computer takes over the task of automatically flying your aircraft. You can jump out of a Harrier at any time, return to the command center, then rejoin the mission from the currently active missions displayed in the pilots room. (The phone shortcut from the Command center to the Pilots' Briefing Room makes it quick to get back to the aircraft.)

Acclimatization Room

This compartment contains an AV-8B flight simulator. Here you can practice flying the AV-8B. Clicking on the up and down arrows on the simulator control console allows you to select the type of training mission you want to fly. The simulator will then put you in the cockpit of an aircraft which has been correctly set up for the sortie. At end of each training mission you are returned to the Acclimatization Room.

Hangar Deck

From here, the AV-8Bs are raised on the deck-edge elevator to the flight deck. Tarawa carries eight aircraft, and this view will show you the number currently available to fly missions. Clicking on the ARM icon will raise and aircraft to the flight deck, then take you to the Weapon Loading Screen, and then into the cockpit to begin a Combat Air Patrol.

Flight Deck

Walking onto the flight deck takes you into the Weapon Loading screen, then into the cockpit to begin a Combat Air Patrol mission. No way points will be set in the Nav system. One Harrier will always be available to fly a Combat Air Patrol.

Primary Flight Control (PRI-FLY)

The island is the tall superstructure on the starboard (right-hand) side on the Tarawa. A glassed-in compartment high up on the island acts as the shipboard equivalent of the Control Tower at a land-based airfield. From here, the Air Officer (known as the "Air Boss") controls flight operations. Seated in a padded chair, he can turn to look out of any of the windows, observing the entire flight deck. Once the amphibious landings get under way, the flight deck will be a busy place at times. Try to stop by Pri-Fly and watch the flight-deck operations. Pressing Keys F1 F2 F3 F4 will allow you look out of the various windows. Esc returns you to the elevator.

Cargo Hold

By visiting the Cargo Hold, you'll get an idea of how much of the on-board stores are still available for use. The number of crates visible gives a general indication of the amount of stores available, and you can assume that the proportion of the stores available on board the other ships in the task force are similar to those on Tarawa. If the Cargo Hold starts to look empty, the cargo holds on the other amphibious ships will be in a similar condition.

Vehicle Deck

The vehicle deck shows the next group of vehicles available to go ashore with the Marines. When the campaign begins, you'll see a group of LVTs (Landing Vehicle Tracked) ready to go ashore. As was the case in the Cargo Hold, this view gives an indication of the vehicle availability for the entire task force.

Simulation Viewpoints

As you've already seen, the game allows you to jump from one aircraft to another, or back to the Tarawa. These are not the only views of the simulated world you can look at. Several keys flip you to more spectacular viewpoints. Before trying this, you'd be advised to hit the A key to engage your aircraft's autopilot. It's easy to crash while admiring the visuals!

Pressing the V key switches to an outside view of your aircraft. You can move around your AV-8B by pressing the appropriate function keys. F3 and F4 will position you 60 degrees on either side of the nose of your aircraft, F5 and F6 will put you 60 degrees on either side of the tail. F7 and F8 will smoothly rotate the view left or right respectively, while F9 and F10 rotate the viewpoint up and down.

Pressing the O key effectively places a TV camera in the sky at your current location, and provides a movie-like view of your aircraft flying off into the distance.

The J key switches to the enemy's viewpoint. This takes you to the selected or designated target. In air combat, this key will take you into your opponent's cockpit, so gives you a quick way of checking that you're not about to be shot down.

If you launch a guided missile, the M key will show you the view seen from the missile seeker. It's not particularly useful, but it can be spectacular.



**SECTION
VII**

FLIGHT TRAINING



FLIGHT TRAINING

Primary Training

If you've never flown a flight simulator, you need to understand the basic rules of how to fly an aircraft. (If you already understand these, you can go directly to the heading "Using the Part-Task Simulators").

An aircraft must be maneuvered in three dimensions - pitch (nose up or nose down), yaw (nose left or nose right), and roll (nose rotated to move one wing down and the other up). In a conventional aircraft, these movements are generated by hinged control surfaces whose position is controlled from the cockpit.

The control column - often referred to as the joystick - is used for pitch and roll control. Yaw is controlled by the rudder pedals. Luckily for computer-based flight simulations, the part played by yaw is relatively minor. Most flying maneuvers are commanded using the control column.

Dozens of old movies on TV will have made you familiar with the how to control an aircraft in pitch, showing pilots pulling back on the control column to bring an aircraft out a dive. Pulling back the control column causes the elevators - moveable surfaces on the aircraft's horizontal tailplane — to deflect upwards into the flow of air caused by the aircraft's forward speed. The result is similar in effect to moving the rudder of a boat. The nose moves in the direction in which the hinged surface was moved. The airflow pushes against the raised elevator, pushing the tail of the aircraft downward, and lifting the nose. Cockpit scenes from old movies showing dive bombers in action illustrate the opposite rule - pushing the control column forward causes the nose of the aircraft to fall.

Given that an aircraft has a moveable rudder surface on its vertical tail, it would be reasonable to assume that steering to right and left is done by moving the rudder to right or left. That works with a boat, but on an aircraft produces a skidding turn which is not particularly useful. The way to turn an aircraft is to roll it in the required direction.

This is done by moving the control column from side to side. To fly to the right, move the control column to the right. A hinged control surface near the right wingtip will rise, while a similar surface on the left wing will droop. These surfaces are known as ailerons, and always respond to control column movements by moving in opposite directions. In this case the right aileron will force the right wing down, and the left aileron will cause the left wing to rise. This will start the aircraft turning to the right. Pulling back on the control column will tighten the turn. Once you get close to the desired bearing, reduce the back pressure on the control column, and move it to the left until the wings return to level.

Centering the controls after demanding a maneuver does not return the aircraft to the straight and level. At first sight, this may seem hard to understand, but an automobile provides a simple analogy. If your driving north, and use the steering wheel to turn onto an eastbound road, returning the wheel to its central position once you're headed eastward does not bring you back to running north. Like the steering wheel on an automobile, the controls of an airplane are used to order a change of direction. Centering them tells the aircraft that the change of direction has been completed.

In a real aircraft, the rudder is controlled by the rudder pedals. In our simulation, you must use the < and > keys. These move the rudder left and right respectively. In a normal flight simulation, the rudder has little effect. Its main function is to make small horizontal aiming corrections, or to final heading corrections when landing. On the AV-8B, it serves another purpose, one which is unique to V/STOL aircraft.

Lift the nose of a conventional aircraft too far, and the speed will start to fall. As the speed of the aircraft falls, so does the speed with which the air flows over the wings and movable control surfaces. Just as a boat's rudder loses effectiveness at slow speed, so do elevators, ailerons, and the rudder. Fly slower still, and the flow of air over the wing is no longer fast enough to maintain the lift needed to support the aircraft.

Effectiveness of the control surfaces falls away steadily, but in the case of wing lift, the deterioration is quite sudden. The upper surface of a wing is slightly humped in cross section, and at speed the airflow across the upper surface will cling to the wing on the rear side of the hump.

If the speed of the aircraft gets too slow, this process breaks down. Instead of staying at the surface of the wing, the air breaks away from the wing along the highest point of the hump. This sudden breakaway sharply reduces wing lift. In technical terms, the wing is said to be "stalled".

Deprived of lift, the aircraft will lose height, and its nose will drop, and the resulting shallow dive will build the speed back up until the wing functions normally. At low level, that height loss can cause you to crash. If you were turning at the time of the stall, the aircraft will enter a spin. Ejection may be the only course open to you.

By moving the nozzles of the Pegasus engine downwards, an AV-8 pilot can substitute engine thrust for wing lift, flying at ever-decreasing speeds below the stall until the aircraft is in a hover. At these low speeds, the control surfaces have no effect, so control is automatically transferred to a system of nose, tail and wingtip mounted reaction jets. Similar to the thrusters used to orientate spacecraft, these reaction jets allow control to be maintained even in the hover. Using the rudder in the hover can send the aircraft pirouetting round - a trick often demonstrated when the Harrier appears at air shows.

Like an automobile, an aircraft has controls for increasing or reducing speed. The throttle controls engine thrust, so works like the accelerator pedal of an automobile. The other control you need to know about is the airbrake. This is a hinged surface which swings downward beneath the fuselage of the AV-8B. It creates drag, reducing the aircraft's speed much faster than throttling back can.

If this is the first flight simulation you've purchased, try the exercises offered by the Part-Task Simulators described below. The take-off exercise will give you the chance to fly around and try out the controls without falling foul of an Indonesian F-16. Once you can maneuver the aircraft, and have fired a few weapons in practice, try your hand at combat missions, opting to fly the Simple Model. This will be easier to control than the Advanced Model. The autopilot is there to help you both in the training exercises and in combat. Don't hesitate to use it, particularly when it's time to land.

Using the Part-Task Simulators

Like USMC pilots assigned to fly the AV-8B, you'll learn to fly the aircraft by carrying out a series of exercises on Part Task Simulators (PTS). These are designed to help to learn the different aspects of flying and combat. You'll find the Part Task Simulators in the Acclimatization room of the USS Tarawa. There are five different PTSs, each of which will take you through one main aspect of the operation of the AV-8B Harrier. Information on recommended flight procedures, and how to aim and fire the weapons is contained in the AV-8B Pilot's Manual, which you should consult before starting your training exercises.

Take-Off

This places you in the cockpit of an AV-8B with no underwing stores. This lightly-loaded condition will allow you to practice vertical as well as short takeoffs. Although able to carry out vertical takeoffs and landings, the AV-8B can carry a heavier weapon load if it makes a short take-off run. The PTS will allow you to try. This section teaches how to take off and land under heavy load conditions, using the vectored thrust to keep take off and landing distances to a minimum. Hovering, manoeuvring in the hover, making the transition to forward flight, then the transition from forward flight back to the hover can all be practiced in this PTS.

Landing

Landing an aircraft aboard a ship is never easy, but Harrier's ability to fly at very slow forward speed supported by downward thrust eliminates two of the hazards of conventional carrier landings — the high approach speed and the need to catch a braking wire with the fighter's tail hook. To quote Mike Gaines, defence editor of the magazine *Flight International*, "It is a lot easier to stop and land than to land and try to stop."

Landing is made harder when the ship is stationary, since this requires the pilot to perform a hover. This simulation teaches the trainee to approach the carrier from the correct angle and height, then to get down without crashing into the island or any other aircraft on the deck. You will start in the cockpit of an AV-8B with no underwing stores.

You will be flying at a height of around 250 ft., and Tarawa is directly ahead of you, about five miles away. The nearest ship visible directly ahead of you is not Tarawa. Don't waste time trying to land on it!

Simple Weapons

This PTS places you in the cockpit of an AV-8B flying at around 550 ft. altitude and heading toward a barge target about seven miles away. The aircraft is armed with Mk81 iron bombs, Hydra rocket launchers and its 25mm cannon. Fly this exercise several times, trying each of these weapons in turn. Diving attacks with guns and rockets are the best way of knocking out small targets, but in combat exposes the aircraft and pilot to the dangers of light AAA fire and the risk of failing to pull out in time, and flying into the ground. Practice your tactics before trying them out against an enemy who shoots back.

Guided Weapons

You're at the same height and facing the same target as in the previous exercise, but now your aircraft is armed with laser-guided versions of the Mk81 bomb (shown in the HUD as "Mk81L", and AGM-65E Mavericks. Try attacking the target barge with both types of weapon.

Air Combat

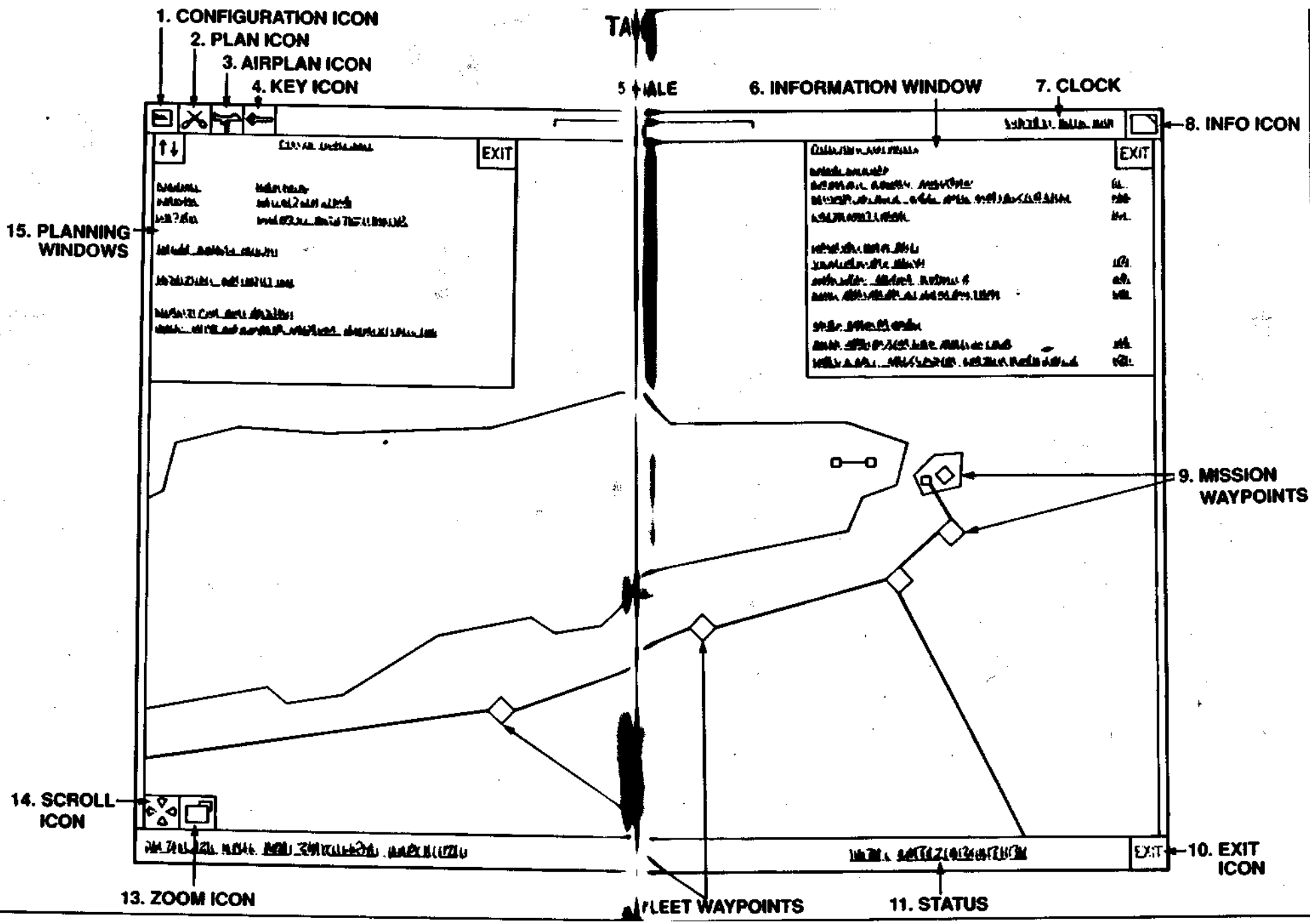
In this case, your target is an unmanned drone aircraft, programmed fly a circular flight path. This will allow you to practice approaches from different angles, engaging the drone either with an AIM-9M Sidewinder or with the 25mm cannon.



SECTION VIII

TASK FORCE COMMANDERS MANUAL





TASK FORCE COMMANDER'S MANUAL

As commander of Operation Ocean Saber, you have two responsibilities. Before the outbreak of hostilities, you must devise an overall plan for the amphibious landing and the subsequent ground battle with the enemy's forces. This will specify the movement of the assault ships and their escorting warships, the targets to be attacked from the air, also the landing points, subsequent movements, and targets for the ground and airborne troops. *

Once the plan is complete, you can start the simulation. As this proceeds under the control of the computer, your job as commander is to monitor the air and ground war, you'll have to "fine tune" the battle plan, responding to the movements of the enemy, and the successes or failures of your own forces.

CREATING A BATTLE PLAN

When planning a campaign, the first step is to locate the most important targets of the map. These are the major towns, the air bases, and the most important fixed military bases. Having noted their position, identify the nearest beaches on which you can send Marines ashore. Can any of these inland targets be "taken out" by units landed by helicopter? Once these airborne forces have landed, and completed their mission, will they be strong enough to beat off counter-attacks?

Once ashore, your Marines will advance to attack the inland targets which you've assigned to them. Use the Tactical Amphibious Warfare Data System (TAWADS) to identify the enemy forces based at these locations, and work out how large an attacking force you'll need, and how much air support you can afford to provide with the numerically-small fleet of AV-8Bs.

Some targets can be destroyed by air attack using the AV-8Bs. Identify these, and decide in which order they should be attacked.

How are you going to deal with the Indonesian Air Force? Attack it on the ground and accept the losses which will result from flying against heavily-defended air bases? Or wait for it to come up and fight?

Many of the Indonesian units are mobile, and will only appear on the TAWADS map if they lie along the route of an AV-8B or helicopter mission which has been flown. To locate those in areas not overflowed by current operations, you may want to launch aircraft on reconnaissance missions to these areas.

Having listed your priorities, determine where to position the fleet. The AV-8Bs can travel to a distant target quite quickly, but the slow-moving landing craft cannot. The closer you are to a planned beachhead, the faster the landing craft can make the round trip to the shore and back.

Having the ships repeatedly rush from one end of East Timor to another to get aircraft and landing craft close to their targets will waste time - try to develop a single integrated plan under which the ships will cruise along the shore, launching their attack missions.

The battle plan contains several components. At the top level are the movements planned for the ships of the task force. These fleet movements are specified as a linked set of numbered way points. At most way points, the task force will launch one or more combat operations.

The heart of the plan you devise will be a route offshore along which the fleet will sail. This route will consist of a series of interlinked way points. At each way point, you will have created one or more operations - air or ground missions which must be launched from this location. These can be assaults by ground forces, attack or transport missions by the fleet's helicopter force, or air missions for Tarawa's AV-8B Harriers.

These operations in turn will follow routes which are themselves a series of linked way points, some of which mark the position of targets which must be attacked. Each combat operation is based on a ship in the task force. When the task force reaches the appropriate way point, the combat operations associated with that way point are automatically launched.

It's impossible to "muddle through" a major amphibious operation. Before starting the campaign, it's essential that you have a clear and coherent plan. The US, British and French units which General Schwarzkopf sent deep into Iraq during Operation Desert Storm knew when they crossed the border where they were going, what to do when they got there, and what to do after that. If you want to win, make sure the Marine units you send ashore are equally well informed.

TAWADS will allow you to create and position way points for the fleet, the AV-8Bs, the helicopters, and the ground forces. It will automatically handle much of the detail, such as way point arrival and departure times, freeing you to concentrate on shaping the overall plan. By the time you've created a plan of your own, you'll realise why the job of commanding a Marine Expeditionary Brigade is normally given to a Brigadier General. It's not easy.

Since the software comes with at least one pre-defined campaign, you may find that examining these will give you ideas on how to construct your own plan. For example, battle plan SABER sends Harriers to the fixed bases to bomb them heavily, then relies on ground forces to mop up the remaining mobile units. This is one potential solution - others may be better.

It's essential that your plan should be balanced. Sending ground forces onto East Timor without air cover will result in them taking heavy losses as they attempt to destroy the fixed bases. You can't just leave the job to the infantry. Don't let the spectacular air component of Desert Storm fool you into thinking that the fight against the Indonesians can be left to air power. General Swarzkopf had hundreds of aircraft at his disposal - you have only eight! If you rely on air power to attack fixed/mobile units on Timor you will probably miss the supporting mobile units. After the AV-8Bs have gone, the mobile forces will get to work to repair the damaged bases.

FIGHTING THE CAMPAIGN

Once a plan has been devised, you can start the simulation running. Once activated, it will automatically generate detailed mission instructions. The computer will act as your staff, passing commands to the units tasked with carrying out the individual parts of your plan. They in turn, will try to achieve what you have asked, them to do. As the fleet reaches each way point, it will launch all the operations due to begin at that location.

As your ground forces are committed to battle, the multi-layer expert systems within the software will react to your actions, taking action with its own forces in real time. Moving in a realistic manner, these computer-controlled enemy units will defend their ground, advance to fight your forces, or retreat.

As the campaign gets under way, you'll then have to monitor the intelligence information and decide how to counter the enemy's moves. In running the battle, you'll have three main sources of information.

1. The TAWADS map display.
2. Intelligence reports.
3. Pilot debriefs.

TAWADS will allow you to assess the progress of the conflict, and to issue direct orders to ground and air forces, ordering them to carry out specific tactical tasks not envisaged in the original battle plan. It will be your job to modify the battle plan, responding both to the movements of the enemy, and to the successes or failures of your own forces. You may have to send out new units or alter the orders of units in the field in order to reinforce a critical part of the battlefield, exploit a breakthrough, or stop a retreat.

Like a good military commander, the expert systems controlling the enemy forces will not waste time in indecision. They will monitor the movements of the US forces, and once combat begins will try to identify tactical weaknesses, and move enemy forces to exploit these. Its view of tactical priorities may not be the same as yours. Look out for the unexpected, and remember that the enemy may respond faster than you anticipate.

Don't forget that as task force commander, you have more information on what the enemy is doing than your commanders on the ground. Your guidance is essential to the efficient operation of your troops. Every action you take effects the world you are playing in thereby giving you a feeling of realism never encountered before. Your decisions and actions, successes and failures will swing the whole conflict one way or the other.

THE COMMAND CENTER

The Command Center has two large wall-mounted displays, and three computer consoles. As was the case in the corridor, the cursor will change shape from an arrow to a cross to indicate possible selections.

The central computer console in the Command Centre gives access to the Tactical Amphibious Warfare Data System (TAWADS), a sophisticated integrated computer system designed to provide command and control over the group's aircraft, weapons, sensors and landing craft.

The monitor on the left-hand side is for Tarawa's Air Data Computer. Clicking on this screen shows the current state of fleet of eight AV-8B Harriers based on the ship. It will report on aircraft lost in action or accidents.

The monitor on the right-hand side is for the Ground Data Computer. Clicking on this will display the latest combat reports from the Marine units operating on shore. These messages will detail major gains or losses of territory made by the Marines, and report casualties.

Remember to check these monitors regularly. If one or more unread messages are waiting on either of the monitors, the monitor will scroll, and its cursor will flash. If it isn't flashing, there are no fresh reports for you to look at.

USING TAWADS

The TAWADS system has 11 operating modes:

BATTLE PLAN SELECTION Selection, overview and activation of battle plans.

BATTLE PLAN CONTROL Control over fleet movements and access to battle plan operations.

OPERATION DETAILS Allows the creation, review and modification of operations associated with the selected fleet way point.

HARRIER WAY POINTS Entry and amendment of individual operational movements of an AV-8B.

HELICOPTER WAY POINTS Entry and amendment of individual helicopter operation movements.

GROUND FORCE WAY POINTS Entry and amendment of individual operation movements by ground forces.

AIR PLAN Give new instructions to an immediate and unscheduled AV-8B sortie.

OVERRIDE Give new instructions to a ground unit for immediate action.

INTELLIGENCE Provides information on a designated unit or location.

KEY Explains the symbols used on the tactical map.

MENU Customises the running of TAWADS.

Each of these modes opens a command window offering tactical information, and most have two levels of control functions.

The first level of control are the options available by clicking on the icons contained within the window. Every window has at least one icon (EXIT or CLOSE), and some have several.

The second level of control is via a submenu. Not normally visible, this can be opened by clicking anywhere in the grey background of the window. This small menu will list the control options available in this particular TAWADS mode.

Display Conventions

On the TAWADS tactical map, the routes between mission way points are drawn automatically. Ground and air routes and way points shown in yellow are currently active. Those shown in light grey are planned operations which have yet to begin, while those in dark grey are history, and have already been completed. With its default display options active, TAWADS does not display missions which have been completed. The way points and route for the fleet are shown in blue.

Inputting Your Commands

The main interface with TAWADS is a two-button pointing device - either a mouse or a joystick. The keyboard is used only to enter names of Plans and Operations.

The left-hand button on the mouse provides the Select function; that on the right provides the View function. The location of the buttons on a joystick varies from one model to another. Later, you'll be shown a simple way of determining which provides the Select function, and which the View function.

The buttons can be used in the normal three ways - to single click, double click, or drag. If the manual simply tells you to "click", use the left-hand button as normal.

The pointer is generally free to move over the entire display, however during certain operations the pointer movement will be restricted to a limited area (for example, during menu operations).

STARTING TAWADS

The centre computer console in the Command Center is the TAWADS display. The green shape visible on the screen is an electronic map of the island of Timor. Clicking on this screen will provide a full-screen TAWADS display. If no battle plan is being executed - as will be the case the first time you look at this screen - a rectangular battle planning window will be open at the top left hand corner of the map.

The TAWADS synthesized map is a simple contour view of the active combat area, in this case the island of Timor. Overlaid on this basic map are symbols indicating the position of towns, villages, and roads. A small white shape offshore marks the current position of the US naval force.

EXPLORING TAWADS

The TAWADS interface can be a bit daunting when first seen, so let's try a simple walk-through of its main features without actually trying to fight a campaign. A window in the battle-planning window should show "SABER", the name of the pre-loaded battle plan. If it doesn't, click on the SELECT icon (the up and down arrows) until SABER is displayed. Now click on GO. The battle-planning window will close, the dock on the top-right of the screen will advance to around 9:30AM. The battle has begun. You'll notice that the fleet has now moved up to the coastline of East Timor.

You'll see various colored lines and symbols overlaid on the map. These represent the opening moves of battle plan SABER. For the moment, let's get rid of them and declutter the screen.

Clicking on the MENU icon will open the Options Menu. Click on DISPLAY OPTIONS, and you'll see a list of features which can be overlaid on the map. The default conditions at startup are for Cultural features, Military Units, Plans - Forward and Plans - Current to be displayed. Click on Plans - Forward to remove these. The menu will close. Reopen it, and click on Plans Current to eliminate these. Now you should have a reasonable decluttered map to explore.

With the map set to its initial relatively small scale, it will still be fairly cluttered, even on a 17" monitor. The first thing you'll want to do is to centre the map on an area of interest, and change the scale to make more detail visible. There are two ways of doing this.

Surrounding the map are control icons. These provide access to the major functions of the system. A single click on any icon performs the function associated with that icon.

The two icons at the bottom left of the screen provide control over the map view.

Clicking on the up, down, right or left arrows within the MAP SCROLL ICON scrolls the map view in the appropriate direction.

Clicking on the MAP ZOOM ICON with the select button decreases the scale of the map, zooming in by a factor of two. Clicking on the same icon with the view button unzooms the view. A little experimentation at this point will show joystick users which button is which. The button which makes the view of the island get larger is the select button; that which makes the view of the island larger is the View button.

A small horizontal marker at the top of the map gives an idea of the amount of terrain being viewed. As the zoom setting is changed this line can indicate anything from tens of meters to hundreds of kilometers (km). Other data displayed on the map surround shows is the current date and time, also the system mode and selected battle plan.

Trying Out the Map

To get an idea of how to use the map, use the MAP SCROLL icon to bring the eastern tip of the island to the centre of the screen. Click on the MAP ZOOM icon several times to zoom in. You'll soon be able to see the individual ships in the fleet, plus several other types of symbol - red diamonds, blue rectangles, and faster-moving orange airplane symbols. These are military units taking part in the battle. Clicking on the KEY icon at the top right will open a window listing the symbols. (This can be closed when no longer required by clicking on its CLOSE icon.)

Keep zooming in, and place names will appear. You'll see that the town nearest the eastern tip of the island is Tutuala. (You may have to use the MAP SCROLL icon to re-center Tutuala.) Zoom in further, and you'll start to see finer detail. For example, there is a small wood some 1 km north-east of Tutuala.

Click right on the MAP ZOOM icon until Lore becomes visible in the bottom right corner of the map. We will use this to become familiar with another way of moving around and zooming on the map.

Place the cursor on Lore, then use the View button to drag it to the centre of the screen. (As you do this, the cursor will change from being a single arrow to a tiny version of the MAP SCROLL icon.) When you release the View button, the map will move to bring Lore to the location where you released the button. If you think of this process as "Dragging Lore into View", you will have a neat way of remembering how its done - a drag operation with the View button.

Move the cursor onto Lore, then click the view button. This will magnify the map by a factor of two centered about the pointer position. Double click with the view button reverses the magnify operation.

To find out more about any location on the map, you need to use the INTELLIGENCE icon. To see this feature in action, click on Lore to expand the scale. Clicking on the INTELLIGENCE icon will open a window giving details of enemy strength in the town.

Use your pointing device to explore the map, zooming in and out to examine some of the towns and villages, checking the identity of the military units you encounter. You'll soon become accustomed to using the map controls, and will be ready to tackle the task of planning an operation.

TAWADS OPERATING MODES

Let's look at each of these TAWADS operating modes in more detail. To help you find the information you need to control combat operations, a standard format is used to describe each mode:

STARTUP - how to enter this mode.

PURPOSE - a summary of what this mode does.

LIMITS ON POINTER MOVEMENT - the area of the display over which the pointer can be moved.

DESCRIPTION - a fuller description of the purpose of this TAWADS operating mode.

COMMAND ICONS - the function of each of the icons contained in this window.

SUBMENU - the command options available from this window's hidden menu.

BATTLE PLAN SELECTION

STARTUP - Automatic on first use of TAWADS. Subsequently by clicking on the PLAN icon on the map surround.

PURPOSE - Selection, overview and activation of battle plans.

LIMITS ON POINTER MOVEMENT - restricted to the battle planning window.

DESCRIPTION - Opened over the top left corner of the map, the Battle Plan Selection window allows the commander to review existing battle plans, create a new plan from scratch, and activate a chosen battle plan. A brief outline of the selected battle plan is shown in the lower half of the window.

Command Icons

SELECT Click left to select the next battle plan.
Click right to select the previous plan.

OUTLINE Edit the outline description of the battle plan.

GO Instructs TAWADS to activate the selected plan.

EXIT Closes this window.

Submenu

Clicking anywhere on background of the Battle Plan Selection window will open a menu offering the following functions:

Review/Change Battle Plan

Review or change the operational details of the selected plan - clicking on this will take TAWADS into the Battle Plan Control mode described in the next section.

AddNewBattlePlan

Create a new battle plan - the system has a maximum capacity for 99 plans, so feel free to create lots of new ones. You will be prompted to enter a name for the plan. Type this, then press RETURN. This newly-created plan will contain no orders. To create the orders which will make up the new plan, re-open this menu, and click on REVIEW/CHANGEBATTLE PLAN option.

Remove Plan

Remove an unwanted battle plan from the TAWADS computer.

If you decide not to carry out any of the above functions, you can exit from this menu by clicking outside of it.

BATTLE PLAN CONTROL

STARTUP - via the map surround PLAN icon when a battle plan is active, also via the Battle Plan Selection sub-menu "review/change" option.

PURPOSE - provides control over fleet movements and access to battle plan operations.

LIMITS ON POINTER MOVEMENT - Map and Battle Plan Control window.

DESCRIPTION - The movement of the task force is directed by a set of way points defined by the battle plan. A way point is a map location where something is scheduled to happen - once arrived there, a military unit is to make a change of course, loiter, or carry out some action. Way points are used to direct the fleet, and to provide start points for operations.

The fleet way points are shown as a linked set of diamonds on the sea. All way points are numbered. Way points which the fleet or other forces have not yet reached can move moved, but not way points that your units have passed. By definition, these are now part of history, so cannot be altered.

Fleet way points can be selected using the pointer select button. The lower part of the Battle Plan Control menu will show the time at which the fleet *is* due to arrive and depart this way point.

Fleet way points can be moved by dragging them with the Select button. This will automatically update the displayed fleet arrival and departure times.

Double-clicking on a way point will take TAWADS into Operation Details mode. Described later in this section, this will allow you to review, change, or add operations associated with this way point.

Command Icons

EXIT - closes the Battle Plan Control window. If your designing a battle plan, this will save any changes you have made to the plan.

Submenu

Clicking anywhere on the background of the Battle Plan Control window will open a menu offering the following functions:

Review/Change Operations

This is the most common function used in plan updating. It activates the Operational Details window control function, allowing review/change to all operations initiated at the currently selected way point. Double clicking on a way point on the map also activates this function.

Add New Way point

This adds a new way point to the plan. When building a plan, you'll normally want to add the new way point at the end of the existing set of way points, so this is where the new way point will normally be placed by TAWADS. If you're modifying an existing plan, you may want to insert a new way point between two existing way points. This can be done by selecting the way point before where you want the new way point to be.

For example, if you want to create a new way point between way points 5 and 6, click on way point 5, open the submenu, then select ADD NEW WAY POINT. A new way point 6 will appear close to way point five, and the later way points in the plan will automatically be renumbered, and their arrival and departure times recalculated.

In every case, the newly-created way point will be positioned close to an existing way point - either the last way point of the intermediate way point you selected. You'll now need to drag it to the final location where you want it to be positioned. TAWADS will automatically compute the new arrival and departure times for this and any subsequent way points.

Remove Way point

This will remove the selected fleet way point from battle plan. Before removing a way point, make sure you have removed any operations associated with this way point.

Change Departure Time

Normally TAWADS will automatically plan a departure time which allows a long enough interval for all the operations you've planned for this way point. If you add more operations, TAWADS will increase the time at this way point to accommodate the extra operations. Sometimes, you may want the fleet to loiter at a way point for a predetermined period of time. Clicking on Change Departure Time will open a submenu showing the current arrival and departure times. Clicking on the minutes displayed in the departure time with the left button will add a minute to the time spent at this way point; clicking with the right button will subtract a minute. Clicking on the hour or the day will change these values in the same way.

OPERATION DETAILS

STARTUP - via the Battle Plan Control window's submenu, or by double-clicking on a way point while in Battle Plan Control mode.

PURPOSE - Allows the creation, review and modification of operations scheduled to start at the selected fleet way point.

LIMITS ON POINTER MOVEMENT - restricted to the Operational Details window.

DESCRIPTION This mode allows you to create, review, modify or delete any of the individual military operations scheduled to take place from this way point. You can add new missions, remove unwanted ones, alter the order in which the individual operations are to be carried out, alter the scale of a ground operation, or assign an operation to a different ship of the task force.

Command Icons

- SELECT** Click left to select the next operation from the currently selected fleet way point.
- Click right to select the previous operation from the currently selected fleet way point.
- The aircraft or troop movements associated with the selected operation are shown in bright green on the map.

Submenu

Clicking anywhere on the background of the Operational Details window opens a menu offering the following functions:

Edit Mission

This allows you to review or change the selected operation. Clicking on it takes TAWADS into either the Harrier Way points, Helicopter Way points, or Ground Forces Way points mode. Consult the relevant heading later in this section for further information.

Alter Detail

Allows you to alter:

The name of a Harrier operation,

The name of a Helicopter operation and the ship from which it is to be launched.

The name, launch ship, and scale of a Ground operation.

Add New Operation

Add a new operation to the battle plan, to be initiated from the currently selected way point.

The creation of a new operation follows a pre-defined structure.

Name

Mission names are generated automatically by TAWADS. The selected alphanumeric code reflects the mission type, way point and the new mission's position in the list on operations due to begin at this way point.

Type

Select operation type from menu. The options are:

GROUND ASSAULT

Helicopter

Harrier

Select Ship

If there is more than one possible ship from which an operation can be based then you will be required to select from a menu of possible bases.

In the case of Ground Assault operations, there will be a third set of options:

Operation Size

Select the size of the planned landing. The options are:

Limited (one landing craft).

Medium Scale (two landing craft).

Full Scale (three landing craft).

Depending on the type of mission being added, TAWADS will now enter either the Harrier Way points, Helicopter Way points, or Ground Forces Way points mode, so that you can define way points and targets for this operation. Consult the relevant heading later in this section for further information.

Remove Operation

Remove selected operation from the battle plan. (This is not possible if the operation is already active or finished.)

Operation Schedule

An Operations Scheduling window will open listing all the operations planned from this way point. These will be listed in date/time order, and the list is scrollable by clicking on the up and down arrows at either end of the vertical orange scroll bar. If an operation has not yet begun, its priority may be changed. Select the operation to be re-scheduled by clicking on the appropriate line in the listing. The line will turn red to show that it has been selected. Clicking on the clock face icon at the top left corner of the Operations Scheduling window with the right button will advance the operation one position up the list; clicking the left button will demote it one position further down the list. When satisfied with the changes, click on this window's Exit icon.

HARRIER WAY POINTS

STARTUP - from the Edit Mission or Add New Operation functions of the OPERATION DETAILS window's submenu, or directly from the AIR PLAN icon on the map surround.

PURPOSE - entry and amendment of individual operational movements of an AV-8B.

LIMITS ON POINTER MOVEMENT - Map and Harrier Way points window.

DESCRIPTION - The Harrier Way points window shows the current operational instruction, which is highlighted red on the map. In planning your route, remember that the AV-8B has no forward-looking radar able to provide terrain-avoidance information. If mountains lie between an aircraft and its target, you should add one or more navigational way points to the planned route in order to take the flight path around these. Way points on the planned flight path may be designated as primary or secondary targets. Way points marking targets should be positioned as accurately as possible on the map, since these mark the point to which the aircraft Nav system will guide you. The more accurately the way point is positioned, the closer the target will be to your flight path, making it easier to locate visually in the forward view.

Command Icons

EXIT - returns control to the OPERATION DETAILS function.

Submenu

Clicking anywhere on the background of the Harrier Way points window opens a menu offering the following functions:

Navigation Way point

Defines the currently selected way point as a navigation way point.

Primary Target

Defines the currently selected way point as a Primary Target.

Secondary Target

Defines the currently selected way point as a Secondary Target, one which is to be attacked if any ordnance is left after successfully attacking the Primary Target.

Remove Way point

Deletes the currently-selected way point from the aircraft flight path.

HELICOPTER WAY POINTS

STARTUP - from the Edit Mission or Add New Operation functions of the OPERATION DETAILS window's submenu.

PURPOSE - entry and amendment of individual helicopter operation movements.

LIMITS ON POINTER MOVEMENT - Map and Helicopter Way points window.

DESCRIPTION - The Helicopter Way points window shows the current operational instruction, which is highlighted red on the map. Way points on the planned flight path may be designated as navigational way points, landing sites for troops, or targets to be attacked.

In planning your route, remember that the helicopters have no forward-looking radar able to provide terrain-avoidance information. If mountains lie between an aircraft and its destination, you should add one or more navigational way points to the planned route in order to take the flight path around these.

Command Icons

EXIT - returns control to the OPERATION DETAILS function.

Submenu

Clicking anywhere on the background of the Harrier Way points window opens a menu offering the following functions:

Navigation Way point

Defines the currently selected way point as a navigation way point.

Drop Troops

This mission will be flown by a transport helicopter, which will land troops at the selected way point.

Attack

This mission will be flown by an AH-1W Cobra attack helicopter, or by a transport helicopter fitted with rocket pods and machine guns or cannon rigged to fire from the fuselage windows. The aircraft will attack a ground target at the specified way point.

Remove Waypoint

Deletes the currently-selected way point from the aircraft flight path.

GROUND FORCE WAY POINTS

STARTUP - from the Edit Mission or Add New Operation functions of the OPERATION DETAILS window's submenu.

PURPOSE - entry and amendment of individual operational movements by ground forces.

LIMITS ON POINTER MOVEMENT - Map and Ground Force Way points window.

DESCRIPTION - The Ground Force Way points window shows the current operational instruction, which is also highlighted red on the map. On reaching a way point, the Marines can engage the enemy forces based there, then either hold the position, or move on to attack another way point.

Command Icons

EXIT - returns control to the OPERATION DETAILS function.

Submenu

Clicking anywhere on the background of the Ground Force Way point window opens a menu offering the following functions:

Navigation Way point

Defines the currently selected way point as a navigation way point. Since the Marines will be coming ashore by landing craft, the first way point must be a beachhead. Troops can only be landed on beaches.

Engage and Occupy

The Marines will engage any enemy forces at this location, and after defeating them will hold and defend this position until given further orders.

Engage and Continue

The Marines will engage any enemy forces at this location, and after defeating them will move on to the next way point.

Remove Way point

Deletes the currently-selected way point from the ground movement plan.

AIR PLAN

STARTUP - from INTELLIGENCE window when an operational unit is selected on map.

PURPOSE - Give new instructions to a ground unit for immediate action.

LIMITS ON POINTER MOVEMENT - Map and Harrier Way points window.

DESCRIPTION - If an AV-8B must be immediately despatched - for example, to re-attack a target which was not destroyed by an earlier strike, or to cope with a newly-detected target not contained in the Battle Plan, clicking on the Air Plan icon will give immediate access to the HARRIER WAY POINTS mode.

The Harrier Way points window shows the current operational instruction, which is highlighted red on the map. In planning your route, remember that the AV-8B has no forward-looking radar able to provide terrain-avoidance information. If mountains lie between an aircraft and its target, you should add one or more navigational way points to the planned route in order to take the flight path around these. Way points on the planned flight path may be designated as primary or secondary targets. Way points marking targets should be positioned as accurately as possible on the map, since these mark the point to which the aircraft Nav system will guide you. The more accurately the way point is positioned, the closer the target will be to your flight path, making it easier to locate visually in the forward view.

Command Icons

EXIT - returns control to the OPERATION DETAILS function.

Submenu

Clicking anywhere on the background of the Harrier Way points window opens a menu offering the following functions:

Navigation Way point

Defines the currently selected way point as a navigation way point.

Primary Target

Defines the currently selected way point as a Primary Target.

Secondary Target

Defines the currently selected way point as a Secondary Target, one which is to be attacked if any ordnance is left after successfully attacking the Primary Target.

Remove Way point

Deletes the currently-selected way point from the aircraft flight path.

OVERRIDE

STARTUP - from the Intelligence icon on the upper right border of the tactical map.

PURPOSE - Give new instructions to a Marine unit operating on East Timor.

LIMITS ON POINTER MOVEMENT - none.

DESCRIPTION - During combat the commander may wish to issue a last-minute change or orders to ground forces already sent into action, overriding their current orders with a new assignment of higher priority. The ground unit to be given the new command must be selected on the map using the Select button. Opening the Intelligence window (if it is not already open) will confirm the identity and current status of the unit).

Submenu

Clicking anywhere on the background of the Intelligence window opens a menu offering the following function:

Override

Selects the new primary target - this is done by clicking on the newtarget.

This change of plan takes place immediately.

CONFIGURATION MENU

STARTUP - from the MENU icon on the upper left border of the tactical map.

PURPOSE - customizes the operation of TAWADS.

LIMITS ON POINTER MOVEMENT - individual menus.

DESCRIPTION - The operation of TAWADS can be configured to meet the preferences of the player.

Submenu

Clicking on the MENU icon on the upper right border of the tactical map will open a menu containing the following options:

Stop Time

This pauses the simulation.

Normal

The simulation runs in real time - this is the normal operating mode when playing the game.

Fast

The simulation runs at four times normal time. This can be useful while units are on the move, but little else is happening - for example, if landing craft are heading from the assault ships to the beachhead.

Step 1 Min

This is an alternative method of temporarily speeding up the game.

Step Next Mission

This advances the game to the point where the next mission is about to be launched. This allows the player to "fast forward" through parts of the plan in which no operations are to be launched. For example, plan

SABER contains relatively few night missions for the AV-8Bs. If none are scheduled, selecting "Step next mission" will advance the simulation to dawn of the next day.

Speeding up time is something a commander will want to do quite often, so you can jump directly to this function by clicking on the digital clock on the upper border of the TAWADS map display.

Pressing any key during time advance will stop the advance and return you to normal time.

Display Options

This lists the features which can be overlaid on the map:

Cultural features	(towns, villages, airports, etc.).
Military Units	(friendly and enemy).
SAMZones	(Areas of terrain protected by surface-to-air missiles).
Plans - Forward	(Military movements due to take place).
Plans - Current	(Military movements currently taking place).
Plans - Past	(Completed military movements).

The default conditions at startup are for Cultural features, Military Units, Plans - Forward and Plans - Current to be displayed.

Preferences

The sole option available here is to adjust the interval of time within which you must make a second click on the mouse or joystick button for this to be recognised as the second action of a "double click". The default is 0.2 sec., but you can choose 0.3, 0.4 or 0.5. If you regularly double-click when using other software (such as applications running under Microsoft Windows), this allows you to set the mouse double-click speed to the value you've become used to.

INTELLIGENCE

STARTUP - from the INTELLIGENCE icon on the upper right border of the tactical map.

PURPOSE - to provide information on friendly and enemy units operating in East Timor.

LIMITS ON POINTER MOVEMENT - none.

DESCRIPTION - Towns, villages, airfields, plus US and Indonesian ground units are shown on the map as symbols. To obtain more information on any of these, click on the Intelligence icon. This will open an intelligence window at the upper right corner of the map, and show information on the selected unit or location. Click on a unit or location using the SELECT button to have the Intelligence window provide a report. You can call up reports on as many units and locations as you wish, and can leave the window open while the game runs — it will continue to display information on the last object you selected.

Command Icon

Close.

Submenu

Strategic Overview: Switches the intelligence window to show strategic information about the overall progress of the campaign. Selecting any object on the map switches the window back to tactical mode.

Command Override: If a ground unit has been selected, clicking anywhere on the background of the Intelligence window opens a menu offering the OVERRIDE function. (See the section on OVERRIDE for details of this mode.)

KEY

STARTUP - from the KEY icon on the upper left border of the tactical map.

PURPOSE - explains the symbols used on the tactical map.

LIMITS ON POINTER MOVEMENT - none.

DESCRIPTION - Towns, villages, airfields, plus US and Indonesian ground units are shown on the map as symbols. To find the meaning of these, click on the KEY icon to open the KEY window at the bottom left corner of the map. This window can be left open while the game is running.

Command Icon

Close.

Submenu

None.



SECTION IX

INTELLIGENCE BRIEFING



INTELLIGENCE BRIEFING

Lower the blinds, lock the door, and post sentries to make sure we won't be disturbed by those not cleared for Secret material. The spooks of the Defense Intelligence Agency have prepared the following classified presentation to guide you through your mission:

THE INDONESIAN ARMY

Current total strength of the Indonesian Army is around 210,000. Provincial and District commands have at their disposal some 80 battalions. Nominal strength of a battalion is around 1,500 - 2,000 men. Most are infantry units, but there are also four airborne battalions, plus eight artillery battalions, and eight for air-defense. East Timor covers some 7,700 square miles. Normal Indonesian Army force level in this region is between 20,000 - 30,000 soldiers, probably 10 - 15 battalions in all.

For years, counter-terrorism and counter-insurgency have been major tasks both for the Indonesian Army and its Special Warfare Command, and for specialised anti-terrorist units such as the Army's Detachment 81 Special Forces, the Navy's Kesatuan Gurita, and the Air Force's Satgas Atbara, and the Satgas Gegana (Counter-terrorist Task Force) of the National Police.

probably the world's most effective counter-insurgency force. Over almost three decades, almost all of the Army's senior commanders have served in East Timor, and regard the campaign as valuable training for the service.

In its anti-guerrilla operations, the Army makes extensive use of helicopters to move its commando forces. Under a scheme designated Territorial Counter-Guerrilla Warfare, the commandos have demonstrated an impressive ability to move, fight and survive by using tactics copied from their guerrilla opponents.

This sort of extended anti-guerrilla campaign has proved costly in financial terms. The East Timor National Council of Maubere Resistance has estimated that the annual cost to the Indonesian Government of its counter-insurgency campaign is \$1,200 million.

Given Indonesia's long-standing and expensive military struggle to end the rebellion, the rulers of Indonesia will almost certainly use their large reserve forces to reinforce East Timor once Ocean Saber gets under way. The Kostrad (Indonesia's strategic reserve) consists of three infantry brigades, three airborne brigades, two regiments of field artillery, an air-defense artillery regiment, and two engineering battalions. There are also two brigades of Marines. Assuming a typical size of 6,000 men per brigade, this provides a reserve force of at least 30,000 men.

The Indonesian Air Force has a fleet of around 19 Lockheed C-130 Hercules transports. Each of these four-engined aircraft can carry more than 100 soldiers or up to 20 tons of cargo on a typical mission. These will almost certainly be used in attempts to ferry soldiers and marines into East Timor, landing them at the airfields on the north coast.

Other reserves exist in the form of the Wanra (People's Resistance) and Kamra (People's Security). These are local auxiliary forces supporting the Army and Police respectively. Lightly armed and with minimal training, neither should pose any threat to the Marines, and are unlikely to be met in combat.

Indonesian battalions are identified by three-digit numbers, and like their US equivalents consist of companies subdivided into platoons. By monitoring radio traffic between units, the general operating area of each battalion has been established, and this information is contained in the databanks of the TAWADS system. Identification does not stretch to companies or platoons, since communications at this level are largely by phone or messenger, rather than radio. Intelligence can thus establish that a town is being held by the 239th battalion, but not that the cook-house was being guarded by the 3rd platoon, 5th company.

To "label" unidentified enemy units, the US Marines use the following scheme:

U/<unitnumber>, <battalionnumber> bn

For example:

U/7, 239 bn

U/1, 409 bn

The "U" in the designation indicates that the identity of this subunit is unknown. Each battalion has its own set of "U" numbers, so the first example would be the seventh subunit of the 239th battalion to have been located.

THE EAST TIMOR RESISTANCE

Although the nominal strength of the East Timor resistance is thought to be around 1,400, this force is in no position to provide assistance to the Marines. The resistance operates in units of between 10 - 50 men, average age being in the teens or early twenties. Shortage of radio communications forces individual units to operate autonomously, without any form of effective central control.

Weaponry is largely small arms, mostly captured M16 rifles, but there is a shortage of ammunition. Lacking a large-scale backer prepared to arm them, the rebels are also short of hand-grenades, and light machine guns, and have no shoulder-fired SAMs able to deal with Indonesian helicopters.

The resistance tends to avoid pitched battles with the Army. It considers itself a political symbol rather than a fighting force, and is only too aware that it lacks the strength and numbers needed to capture and hold territory. Once the Marines land, we expect the resistance will do its best to harass the defenders with ambushes and diversionary hit-and-run attacks, but it lacks the weapons and manpower to take direct part in the fighting.

INDONESIAN NAVY

Under normal circumstances, the 17 frigates, four Exocet-armed fast-attack craft, and two submarines of the Indonesian Navy would pose a formidable threat to the US task force. However, the Indonesian Navy took no part in the coup, and has publicly distanced itself from the ruling junta. Through diplomatic channels, senior Indonesian Navy commanders have informed the US Government that their service will not oppose any UN-sanctioned action against Army and Air Force units in East Timor. The US Government has in turn assured the Indonesian Navy that its neutrality will be respected, provided that its warships remain north of East Timor, and at least 10 miles from the island's northern coastline. This condition has been accepted by the Indonesian Navy, but to avoid the risk of accidental confrontation between the two navies, the President has directed that the US fleet remain south of East Timor throughout Operation Ocean Saber.

INDONESIAN AIR FORCE

The Indonesian Air Force is relatively small, but well equipped. With limited funds for aircraft purchase over the years, the Indonesians have always chosen wisely. Every type of jet fighter currently in Indonesian service was good enough to be selected by the US Air Force and Navy as "aggressor" aircraft for Top Gun and other air combat training schemes.

F-16 Fighting Falcon

The newest and most potent warplane you'll face is the single-engined General Dynamics F-16 Fighting Falcon. A batch of 12 - eight single-seat F-16A and four two-seat F-16B - entered service in 1990. These are basic Block 15 version of the aircraft, rather than the more potent Block 50/52 model now in service with the USAF, but it remains an agile and highly effective fighter. On paper, the F-16 totally outclasses the AV-8B in air combat. It has a top speed of around Mach 2.0

compared with the Mach 0.85 of the AV-8B, while its combat ceiling of around 50,000ft is around 5,000 ft. above that of the Harrier II.

In practice, most modern air combat takes place at altitudes of less than 20,000ft, and at speeds ranging from Mach 0.8 - 1.2. Here the difference between the two aircraft is less obvious. Under typical combat conditions, the AV-8B and the F-16 are in a similar weight category. The F-16's Pratt & Whitney F100 engine generates about ten per cent more thrust than the Rolls Royce Pegasus in the AV-8B, but burns about twice as much fuel when doing so.

An F-16 can only reach full engine thrust by using a fuel-hungry afterburner. Any extended use of afterburning will have the enemy pilot peering nervously at his fuel gauge and wondering if it's time to head for home. The AV-8B develops full thrust without afterburning, so its pilot can make more use of full power in combat. When attacked by F-16s, use that thrust, plus all the maneuvering advantage which can be obtained from "viffing". Try to fight on your terms, not his.

The main air-to-air armament of the F-16 is the AIM-9 Sidewinder plus a built-in 20mm Vulcan cannon. The latter has a similar rate of fire to the 25mm cannon carried by the AV-8B, but its 20mm shells cannot match the explosive power of the larger 25mm projectiles. The export version of Sidewinder supplied to Indonesia is less sophisticated than the AIM-9M used by the AV-8B, so should be more vulnerable to decoy flares.

Indonesia uses the F-16 both as an air combat fighter and as a strike aircraft. On a short-range attack mission, an F-16 can carry up to 12,000 lbs. of bombs. If F-16s are sighted, always remember that their target may not be you, but Tarawa or one of the other ships in the fleet.

F-5 Tiger II

Much the same applies to the other supersonic fighter in Indonesian service - the Northrop F-5E and F-5F Tiger II. Top speed in this case is Mach 1.64 at 36,000ft, while the combat ceiling is 54,000 ft. The F-5 lacks the high thrust-to-weight ratio of the F-16, but its high maneuverability makes it a dangerous opponent. In the 1970s, this aircraft was used by the "Aggressor" and "Top Gun" training units of

the USAF and USN, who found it well-matched to the task of simulating the small and agile Soviet MiG-21.

Ten single-seat F-5E and four two-seat combat capable trainers are currently in service. They have two 20mm internal cannon, and can carry AIM-9 Sidewinder, or several tons of bombs.

A-4 Skyhawk

The final aircraft you can expect to meet is the McDonnell Douglas A-4E Skyhawk. Originally developed as a lightweight shipboard attack aircraft, this small subsonic bomber can carry up to 8,000 lbs. of ordnance, including bombs and unguided rockets. Britain's Royal Navy lost several warships to A-4 attacks during the Falklands War, and the 26 in Indonesian service will pose a high threat to the amphibious-warfare ships of the US force.

After releasing its bombs, the A-4 is a capable subsonic opponent in air combat. It can carry the AIM-9 Sidewinder, and has a built-in armament of two 20mm cannon. In air-to-air combat, US and Israeli Skyhawks have used cannon or unguided rockets to down MiG-17 and MiG-19 fighters. Indonesia's pilots will be hoping to add the AV-8B to this list, so treat the A-4 with respect in a dogfight. It's not known as "Heinemann's Hot Rod" for nothing!

Other Aircraft

Indonesia's final operational jet is the British Aerospace Hawk advanced trainer. Although an effective light-strike aircraft, it is not currently based in East Timor, and you are not likely to meet it in combat.

The final type of aircraft in East Timor is the Bell Model 205 UH-1 Iroquois, better known to the US services as the "Huey". The 16-strong fleet is operated by the Army rather than the Air Force. Widely used as light troop transports, these can carry between 11 and 14 soldiers. Since these are regularly used as light inter-island transports, it is impossible to determine how many of the 16 are currently in East Timor.

GROUND TARGETS IN EAST TIMOR

Mobile Units

Years of anti-rebel operations have taught the Indonesian Army the virtues of mobility. Much of the strength of the resident garrison will probably be found in small groups of between two and six tanks, personnel carriers, trucks, or other heavy vehicles. Normal deployment practice is for these to be stationed around fixed bases, villages and towns, but there should also be opportunities to attack such units while they are on the road travelling operating locations. These units will move when and if they are required to support their home bases. The position of mobile units will not be known until they have been sighted by US aircraft.

Fixed Bases

Typically these will be military camps, with several buildings and bunkers. Some have radio antenna masts. Installations of this type are positioned at road junctions and further intelligence information relating to these can be found in the TAWADS databanks.

Fixed bases are always supported by a number of mobile units, the number depending on the importance of the base. Some indication of the number of mobile units around a fixed base should be available to pilots during their pre-mission briefing, and more exact information on the mobile units which have been detected by US aircraft will probably be available from TAWADS. These defending units may have shoulder-launched SAMs.

If a fixed base *is* attacked, normal Indonesian Army doctrine is for the surrounding mobile units to regroup around the base and support it. These include engineering units which will probably attempt to repair damaged bases. If you destroy the buildings in a base, but fail to hunt down and destroy any enemy mobile units in the locale, those building could quite quickly be repaired and returned to operational status.

Fuel Dumps

Petroleum, Oil, and Lubricant (POL) supplies for the Indonesian forces in East Timor are stored in several Fuel Dumps. These are major

installations with large above-surface fuel tanks on ground. The latter will be highly vulnerable to air attack, but pilots should avoid overflying at low level the massive explosion which results from the destruction of a filled fuel tank. Like the Fixed Bases, fuel dumps are located near road junctions, and will protected by a significant defensive force.

Air Bases

Five air bases have been identified. All are heavily defended by both fixed and mobile units. The two biggest air bases are Dili and Vila Salazar on the north coast. Dili also serves as the civil airport, having taken over this role from Vila Salazar. By local standards, both are major airports with several runways, substantial numbers of hangers and other buildings, and a control tower. These are the main operating bases for the F-16s, and would be the arrival point for any Indonesian reinforcements flown in by air.

Three smaller bases are at Suai, Same, and Viqueque on the south coast. These have a single runway and several hangers, and are normally used by the F-5 force. The possibility of F-16s being moved forward to these bases cannot be ruled out.

Electronic intelligence gathering has produced no evidence that the Indonesian Air Force is planning a pre-emptive strike on the fleet. Fighters are unlikely to be scrambled until US warplanes approach Indonesian airfields or begin attacking targets on East Timor.

SAM Sites

All the SAM systems in service with the Indonesian forces are either mobile or easily transportable. Normally these are kept at fixed bases, but electronic intelligence gathering operations conducted over the last eight hours suggests that these are now being deployed under cover of darkness to their operational positions. As soon as a SAM site is detected, the area it covers will be noted in the TAWADS databanks.

Villages and Towns

These have no fixed defenses, but mobile units may be based around them.

INDONESIAN ARMY EQUIPMENT

Since seizing power, the military junta has embarked on major purchases of military hardware. These have greatly increased the striking power of the Army, particularly in terms of tanks, artillery, and surface-to-air missiles.

Standard main battle tank is now the Chinese T-59, a version of the Soviet-developed T-54/55. Armed with only a 100mm gun, these 38 ton tanks are outclassed by the US M1 Abrams. Although crudely made, these are reliable and well-armored for their weight class. If unsupported by the small number of tanks available to the landing force, Marine units which encounter T-59s should be able to deal with these using TOW anti-tank missiles. The T-59 will also be vulnerable to attack by the AV-8Bs or AH-1W attack helicopters.

The main artillery used by the Indonesian Army is a Chinese-built version of the Soviet 122mm D-30 howitzer. With a maximum range of just over 9.5 miles (15km), these are out-ranged by the more modern M198 howitzers used by the Marines.

Two types of mobile Anti-Aircraft Artillery (AAA) have been purchased in large numbers. The heaviest is a Chinese-built version of the Soviet ZSU-57-2 - a twin-barrelled 57mm gun mounted on a T-54 tank chassis. This is a relatively slow-firing weapon, but a single hit can do massive damage to your aircraft.

Much more likely to score a hit is the radar-guided ZSU-23-4 Shilka radar-guided AAA gun, significant quantities of which have become available on the international market with the collapse of the former Soviet Union. Mounted on a PT-76 tracked chassis, this four-barrelled weapon combines accuracy with a high rate-of fire.

Until recently, Indonesian surface-to-air missile (SAM) defenses were restricted to small numbers of British and Swedish systems, but these have not been deployed in east Timor. The SAM defenses of East Timor are based on two types of missile purchased from one of the former Soviet republics. The SA-3 is a transportable command-guided SAM with a maximum range of up to 15 miles (25km). The smaller SA-6 is mounted on tracked vehicles, and has a range of 18 miles (30km)

against low-altitude targets, or about twice this distance against aircraft flying at high altitude.

SA-3 and SA-6 will probably be used to defend airfields, and other high-value targets such as fixed bases and fuel dumps. Flying at very low altitude (around 300 ft.) should dramatically reduce the effectiveness of both types of SAM, but will increase the risk posed by AAA weapons. The ALQ-164 jamming pod should also reduce the effectiveness of these missiles, as will the release of chaff.

Mobile units have been armed with the Chinese-built HN-5, an improved version of the Soviet SA-7 shoulder-fired missile. This is a heat-seeking missile, with a maximum range of around two miles (3.5km). The best counter to this weapon is to release flares.

INDONESIAN COMBAT PERFORMANCE

The Marines have the edge over Indonesian soldiers in both quality of equipment and level of training. In a firefight against an Indonesian mobile unit, a US unit of similar size will probably win with minimal casualties. When sent against defended fixed bases, the Marines will be at a disadvantage, since they not only cope with dug-in defenders, but must also concentrate on trying to destroy base facilities. Without air support, the Marines are likely to take significant casualties in such an attack. You are advised to bomb fixed bases using the AV-8Bs, then send in the Marines to mop up any remaining defenses. If this is not possible, the AV-8Bs should at least provide Close Air Support for the attacking Marine forces.

THE HARRIER AT WAR

Harrier has twice seen combat action. USMC AV-8Bs were deployed to Saudi Arabia in 1990, and played a successful role during Desert Storm. Almost a decade earlier, Britain successfully used the aircraft during the 1982 Falklands War. Both campaigns illustrated the strengths and weaknesses of the aircraft, offering useful lessons for the current East Timor campaign.

OPERATION CORPORATE: THE LIBERATION OF THE FALKLANDS

On April 2nd 1982, Argentinian forces invaded the Falkland Islands, overcoming the token UK military forces stationed there. The US Navy believed that the recapture of the islands by Britain was a military impossibility, a view obviously shared by Argentina. This view overlooked the presence of two strong-willed individuals - British Prime Minister Margaret Thatcher, and the head of the Royal Navy, First Sea Lord Sir Henry Leach. Even before the Argentinian fleet had reached the Falklands to begin what Argentina saw as the liberation of part of its territory, Leach had begun to assemble the naval task force whose first elements would depart for the south Atlantic on April 5th.

Britain's Royal Navy no longer operates full-sized aircraft carriers able to operate conventional catapult-launched fighters. To provide air cover for the task force, the UK had to rely on the Sea Harrier. A total of 28 were deployed on two vessels. Invincible was the first of a new class of light carriers, while the larger Hermes was a conventional carrier which had been rebuilt as a helicopter equipped assault ship. To improve the endurance and firepower of the Sea Harrier, a modification program fitted the aircraft with larger drop tanks, and increased its armament from two Sidewinders to four.

In theory at least, the British aircraft should have been no match for Argentina's top fighters. The 21 Mirage III and 26 examples of the Israeli-built Dagger copy of this French fighter were supersonic aircraft with a top speed of Mach 2. Luckily for the British, the Mirage is a delta-winged aircraft, a configuration which requires a long runway. The airfield at Port Stanley was the largest in the Falklands, but had too short a runway to handle these aircraft. The Mirages and Daggers had to fly their combat missions over the Falklands from bases on the Argentinian mainland. Like the Messerschmitt Bf109 fighter which escorted Luftwaffe bombers attacking Southern England fifty years earlier, the Argentinian fighters were forced to carry external fuel tanks to extend their range, and even with these could spend only a few minutes flying at full power in the combat zone.

On May 1, Hermes launched 12 Sea Harriers to carry out attacks on the airfields at Port Stanley and Goose Green. An hour after their return, these aircraft were once more airborne on air-defense patrols. Despite being outnumbered six to one, the force of 28 Sea Harriers scored 20 'kills' and three 'probables' during the brief war. Sixteen of the Argentinian aircraft were downed using the AIM-9L Sidewinder, the other four by fire from the Sea Harrier's internal armament of two 30mm Aden cannons.

Six Sea Harriers were lost. One was shot down by a Roland surface-to-air missile, the other by AAA. The remaining four were lost in accidents - one crashed after take-off, while the others fell victim to the foul South Atlantic weather. Two which went missing while on patrol are believed to have collided in poor visibility, while another rolled off the deck of the carrier and fell into the sea.

To supplement the small Sea Harrier force, 14 Royal Air Force Harrier GR.3 fighters were selected to handle much of the ground-attack role. RAF pilots were hurriedly trained in the art of flying from a carrier, while their aircraft were modified to carry AIM-9L Sidewinder missiles. These aircraft were flown to Ascension Island. Six were sent to the south Atlantic aboard a container ship, then transferred on arrival in mid-May to the flight deck of Hermes. Two more flew from Ascension to Hermes, arriving on June 1, and were followed by a further two which arrived on June 8th.

The RAF Harrier GR.3s flew 125 ground-attack and tactical reconnaissance sorties in the face of heavy defensive fire, mainly from light anti-aircraft weapons. Three of the 10 aircraft were lost in action, all believed to have been the victims of anti-aircraft gunfire. "Most aircraft engaged in offensive support survived damage, which usually resulted from intense Argentinian anti-aircraft gunfire", said the British Government's official report on the campaign. Most of the close-support missions used unguided bombs, the British BL775 cluster bomb proving particularly effective.

Throughout the brief war, task force commander Rear Admiral John "Sandy" Woodward was aware that the success of the amphibious landing would depend on the survival of his two aircraft carriers, particularly the flagship Hermes. Wherever possible, he kept these

vessels well east of the Falklands, and thus out of range of the Argentinian Mirages, Daggers, and Skyhawks. Even at this distance, Woodward still faced the threat of attack by fighter-bombers equipped with the French-built Exocet anti-ship missile, but Indonesia has no weapons of this type.

For Ocean Saber, the US has only one carrier, while the number of AV-8Bs available is around a fifth the size of Woodward's combined force of Sea Harrier and Harrier GR.3 aircraft. This small air component must handle both the air-to-air and air-to-ground missions, flying against an air force about a third the size which Britain faced in 1982. Without Tarawa and its AV-8Bs, the landings are doomed to failure. Lose Tarawa, and you lose the campaign.

During the Falklands War, the Argentinian Air Force made two main tactical errors. One was for its fighters to launch their missiles at maximum range, then turn away to retreat at supersonic speed. The Sea Harriers were able to dodge the incoming missiles, close the range, then fire their own Sidewinders. The other was the fact that for most of the brief war, aircraft tasked with attacking the fleet concentrated their fire on the escorting warships rather than the amphibious ships and transports. Destroyers and frigates could be replaced by others despatched to the South Atlantic in the wake of the main task force, but the carriers and their aircraft, plus the assault ships and transports with their cargo of soldiers and equipment were irreplaceable.

Neither error is likely to be repeated by the Indonesians. The F-16 has a much longer range than the Mirage and Dagger, so will have ample time to engage the AV-8Bs. It also has a much higher performance than the Argentinian fighters, and is armed with more effective air-to-air missiles. Unlike Rear-Admiral Woodward, the commander of Ocean Saber does not have a supply of fresh escort vessels. Like the amphibious ships and transports, Kidd and her Perry-class companions are irreplaceable.

OPERATION DESERT STORM: THE LIBERATION OF KUWAIT

The part played by the AV-8B in Desert Storm was relatively small. Two squadrons of AV-8B were among the first Marine aircraft to arrive in Saudi Arabia. By the time that the air war began, 60 AV-8B were operating from shore bases, and a further 26 aboard amphibious-warfare ships operating in Gulf waters. This was a total of four squadrons and one detachment.

The land-based aircraft operated from King Abdul Aziz Airfield. This was the most northerly airfield used by the Allies, and ensured a short flight time to the combat zone. Other deployment locations included rough airstrips and concrete forward sites.

The AV-8B went into action on the first day of the ground war, knocking out Iraqi artillery which was bombarding Marine ground positions near Khafji. By the end of the Gulf War, the small force AV-8B force had flown more than 3,380 combat sorties, and some 4,000 flying hours. During this time, they delivered more than 5.9 million pounds of ordnance. Mission capable rate averaged 90 per cent.

To stay out of SAM and light AAA fire, AV-8Bs typically flew at an altitude of around 15,000ft - high enough to stay out of trouble, but low enough to see trucks moving on the ground. Assigned a primary and secondary target within a 30 by 30 mile "kill box", pairs of aircraft would make diving attacks on their designated targets. If these couldn't be found, pilots would follow the roads until they found a target. Few AGM-65 Mavericks were used by the AV-8Bs; the best warload turned out to be between four and six bombs mounted one per pylon. These were normally 500 lbs., 1,000 lbs. or Rockeye bombs. In a typical CCIP attack, the weapons would be released at around 6,000ft while the aircraft was flying at around 525 kts. in a 45 degree dive. At first, the AV-8Bs would trade two bombs for Sidewinders, carrying four bombs plus two missiles, but the absence of the Iraqi Air Force made this a pointless precaution. The number of Sidewinders carried was reduced to one under the left wing, then to zero.

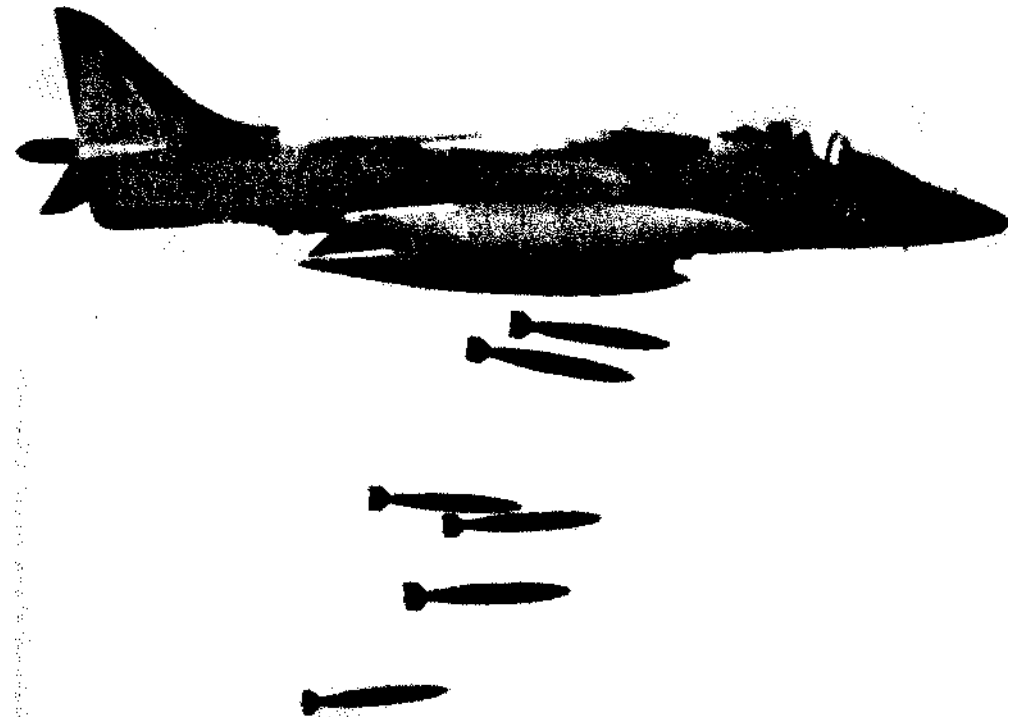
Five AV-8B were lost in combat - two from VMA 542, and one each from VMA-231, 311. and 331. Two of the pilots - Captain James M. Wilbourne of VMA-542, and Captain Reginald C. Underwood of VMA-331 were killed. Captains Michael C. Berryman (VMA-311) and Russell A. C. Sanborn (VMA-231) were taken prisoner, and later released, whilej Captain Scott Walsh of VMA-542 was rescued.

Combat experience showed that the aircraft's main weakness was the location of its engine nozzles. Heat-seeking missiles home of the hottest part of the target, which is normally the jet pipe. On a conventional fighter, hits from light heat-seeking missiles tend to be on the tail, but on the AV-8B the hot jet pipes are much closer to the engine and cockpit area.

Gulf War combat experience shows versatility of the unguided bomb, particularly the Rockeye, and the wisdom of staying above the ceiling of light AAA weapons. If losses due to heat-seeking SAMs build up during Operation Ocean Saber, it may be advisable to carry an external chaff/flare dispenser so that you can drop flares more frequently during your attack.



HISTORICAL BACKGROUND



HISTORICAL BACKGROUND

DEVELOPMENT OF THE HARRIER

At Britain's 1968 Farnborough Air Show, three officers of the US Marine Corps walked into the hospitality suite of the British company Hawker Siddeley Aviation and announced "We're interested in the Harrier". The US services are not in the habit of buying jet fighters from an overseas supplier, but this was the start of a process which would see the US taking into service Britain's revolutionary vertical takeoff and landing (VTOL) fighter, and which would lead to today's AV-8B Harrier II.

To an Englishman, the sale of Harrier to the US Marines might be seen as evidence that his nation can still teach the "Yanks" a thing or two about aviation, but in fact US involvement in the Harrier program dates back to the late 1950s. Without US financial assistance, the airplane would never have left the drawing board.

Back in the mid-1950s, the Cold War was at its peak, and the NATO allies had based their air plans on a network of 8,200ft runways based in Western Europe. These would have been priority targets in wartime, a fact which led French airplane designer Michel Wibault to propose the Gyroptere, a ground-attack fighter able to take off and land vertically.

The idea of a vertical takeoff and Landing (VTOL) fighter was not new. Several experimental aircraft had already flown, and others were being built. Some, like the turboprop-powered Convair XFY-1 and the jet-powered Ryan X-13 Vertijet, were "tail-sitters." From a vertical starting position, these climbed away from the take-off point under the power of their main engine, then reversed this maneuver in order to land.

An alternative solution explored by aircraft such as the Shorts SC.1 involved taking off with the fuselage in the normal horizontal position, the aircraft being raised by a battery of downward-pointing lift engines.

Both arrangements had disadvantages. The pilot of a tail-sitter was in a most uncomfortable position during take-off and landing - the very times when his concentration needed to be at its highest. This was not the case with an aircraft which used lift jets; here the problem was that the lift engines occupied much of the internal volume of the fuselage, reducing the amount of fuel which could be carried, and for much of the flight were simply unwanted dead weight.

Wibault proposed to get around these problems by using vectored thrust. A single huge engine whose thrust was greater than the aircraft weight could lift the aircraft if its thrust could be directed downward, then propel it in normal flight by directing the thrust rearward.

This idea had been tested in 1954 with the twin-engined Bell Model 65 Air Test Vehicle, and would be explored further in the new Bell X-14 then under construction in the USA, but these aircraft were too small to perform any military task. On the tiny Model 65, the two J44 jet engines were mounted outside of the fuselage and could be moved from rearward or downward-thrusting positions. For the X-14, two British-built Armstrong-Siddeley Viper turbojets would be mounted side-by-side within the forward fuselage, discharging their exhaust through belly-mounted steerable cascade nozzles.

In a conventional aircraft, safety is improved by having multiple engines. If one fails, the aircraft can keep flying. This isn't the case with a VTOL aircraft - any significant loss of thrust while in the hover will turn that hover into a crash. Having multiple engines simply increases the chance of an engine failure. This was the problem faced by 1950s designs such as the Model 65, the X-14, and the Shorts SC.1, and by today's Yakovlev Yak-38 Forger and Yak-141 Freestyle V/STOL fighters.

For the Gyroptere, Wibault planned that the thrust would be generated not by several jet engines but by four steerable air blowers, all mechanically driven by the most powerful engine he could find - the Bristol Orion. Rated at around 8,000hp at sea level, this would be connected to the blowers by a system of shafts and bevel gears. The four blowers would be angled downwards to provide the thrust needed for vertical takeoff, then turned to face aft to create the power for conventional flight.

Conventional control surfaces such as ailerons, elevators and rudder obtain their effect by deflecting the rapid flow of air passing around the aircraft's wings, tail fins, and rudder. When the Gyroptere was hovering or flying at low speed, they would be useless. Wibault realised that a practical VTOL aircraft would require a second control system for low speed flight and hovering. He proposed to fit the aircraft with a system of nose, tail, and wingtip-mounted reaction control jets. Fed by compressed air, these would be used to maintain control until the airplane was flying fast enough for conventional control surfaces to take over.

Unwilling to fund such a novel airplane, the French suggested that Wibault apply for funding from the Mutual Weapons Development Programme (MWDP), a scheme under which the US could fund promising foreign weapons. Gyroptere was too complex to be practical, but gave two British companies - Hawker and Bristol Aero-Engines — the inspiration to devise a more sensible design.

Bristol engineers looked at Wibault's proposal, and decided his estimated weight of only 1,080 lbs. for the four blowers and bevel gearboxes was unrealistic. Instead, they proposed that the Orion engine should drive a single large fan section "borrowed" from the company's much larger Olympus engine. This in turn passed its output of compressed air to two steerable nozzles.

Hardly had this BE.48 engine been sketched out on the Bristol drawing boards when Hooker realised that Bristol's new Orpheus jet engine would make an even better power source than the Orion. This BE.52 engine design was equally short-lived. The improved BE.53 eliminated the gearbox used to drive the fan. Instead, the fan was driven by its own turbine stage.

The idea of using a second turbine was not new. Until 1949 all jet engines had used a single shaft. Air from the inlet was compressed by a multi-stage compressor, whose airflow entered a combustor section, where the fuel was burned. The hot efflux gases leaving the combustor passed through a turbine used to drive the compressor, before passing to the jetpipe.

This layout was simple, but the rotational speed of the turbine-driven shaft which drove the compressor was always a compromise between the optimum speed needed by the early stages of the compressor and the speed best for the later stages which were handling a higher-pressure airflow.

In 1949 two engine manufacturers - Pratt & Whitney and Bristol Engines - tested new engines which introduced a twin-shaft layout, a configuration still used for most present-day aero engines. A low-pressure (LP) fan feeds air to a high-pressure (HP) compressor. After fuel has been burned in this HP airflow, the hot gases pass through an HP turbine used to drive the HP compressor, then an LP turbine which drives the LP fan, before passing to the jetpipe. The two sections of the engine - LP and HP - can each rotate at the speed which gives highest efficiency.

On the B.53, the fan did not feed the HP compressor. All its air went to the two large steerable nozzles. Two small inlets mounted directly above and below the fan were used to feed air to the Orpheus section whose hot exhaust gas was released from a rearward-facing jetpipe just as in a conventional engine. Since all the compression was done by a compressor which was entirely driven by a single shaft and turbine, the BE.53 was not a true two-shaft engine, but it promised enough power to allow the design of a warplane.

In the spring of 1957, the Hawker team led by Sir Sidney Camm, designer of the World War II Hurricane, Typhoon and Tempest piston-engined fighters, drew up plans for what was then known as the P. 1127. With its ugly tadpole-shaped fuselage, unswept mid-set wing, and tail wheel undercarriage, this design looked more like the primitive jet fighters of the mid-1940s than a combat aircraft for the 1960s. Air from the nose inlet entered a BE.53 engine in the lower part of the center fuselage. The two steerable nozzles were located on either side of the fuselage directly under the wing, the jetpipe emerging from the lower fuselage just aft of the wing. A slim rear fuselage led to a tail assembly which would not have looked out of place on a Second World War piston-engined fighter.

Since only part of the thrust of the BE.53 was vectorable, the aircraft was designed for short rather than vertical take-offs and landings. Its

take-off and landing speeds would be too low for aerodynamic controls to be effective, so Camm's team planned to feed some of the fan air to a system of nose, tail, and wingtip-mounted reaction control jets similar to those first proposed by Wibault. Too small and lacking in engine thrust to carry a warload, the P. 1127 was proposed as a lightweight reconnaissance aircraft.

While this design work was going on, back at Bristol Engines, Hooker's team had come up with further improvements. In a normal two-shaft engine, the task of the fan stage is to provide LP air for the HP compressor. The new engine now being sketched out on Bristol drawing boards had an oversized fan which produced enough LP air to feed not only a pair of steerable nozzles, but also the HP compressor. Having passed through the HP and LP turbines, the hot engine efflux entered not a single conventional jetpipe, but a pair of steerable aft nozzles. All four nozzles of this "four-poster" arrangement could be simultaneously moved so that they pointed downward to provide the vertical thrust needed for VTOL, then backward to power the airplane for normal flight.

This new engine allowed the Hawker team to make a fresh start. By the autumn of 1957 they had created a design able to take-off and land vertically. Although the wing was still unswept, it was recognisably the ancestor of today's AV-8B Harrier II.

The new airplane and engine could not have been born at a worse time. The British Government had just decided that the manned combat aircraft was obsolete, and opted to cancel virtually all its current warplane programmes in favor of guided missiles. The idea of a VTOL fighter fell on deaf ears.

US defense planners rejected the British idea of all-missile air forces as naive, and agreed to meet 75 per cent of the cost of developing the new airplane and its engine. Refused British funding, the two partner companies used their own money to make up the remaining 25 per cent. Not until late 1959 did the British Government agree to help fund the two P. 1127 prototypes taking shape at Hawker's Kingston factory.

Camm and his team wanted to create not just a flying testbed able to demonstrate V/STOL technology, but an airplane which could serve as an operational fighter. The structure was built strong enough for

combat, and with the internal volume needed to allow the installation of mission-related avionics. The problem they faced was that in any VTOL airplane, the total weight at takeoff must be less than the thrust created by the engine. Get the airplane too heavy or be faced with an engine unable to develop the specified thrust, and it will refuse to fly - a fate not unknown in the history of VTOL aircraft!

In September 1959 the new engine, now named Pegasus 1, started running on the test bench. It developed only 9,000 lbs. of thrust, but showed that the concept of a "four-poster" vectored-thrust engine worked. An engine suitable for flight would have to generate more thrust, plus a supply of HP rather than LP air for the reaction-control system. Studies had shown that the amount of LP air needed for reaction control would reduce engine performance, and require bulky ducting to feed it to the wingtip, nose, and tail reaction jets. To be practical, the system would have to be redesigned to use high-pressure air drawn from the engine's HP section.

To provide the extra thrust and a source of HP bleed air, Bristol devised the Pegasus 2 engine, which ran for the first time in February 1960. The best that Bristol designer Stanley Hooker could promise was 11,000 lbs. of thrust, giving Camm the problem of packing this large engine into an airplane about the weight of a Korean-War-era F-86 Sabre. Redesigning the reaction-control system was not easy. The HP bleed air from the Pegasus 2 was available in the quantities needed to do the job, and at pressures high enough to allow small and compact ducting. Unfortunately it left the engine at a temperature of around 660 deg F, so had to be ducted via pipework made from Nimonic alloy, a material originally designed for use inside jet engines.

By October 1960, the first P. 1127 airplane was ready to fly. It left the ground for the first time on October 21st, beginning the first of a series of tethered tests intended to explore handling in the vertical mode. The margin between aircraft weight and engine thrust was very low during these first flights, allowing enough fuel for only two minutes of hovering flight. By early November, test pilot Bill Bedford and the P. 1127 team were ready to try free flight. To do this involved the additional weight of installing a radio in the cockpit at a time when every pound was vital. The first untethered flight was on November 19th. Soon afterwards, the British Government finally agreed to pay for

a batch of four development aircraft. Bristol - now known as Bristol Siddeley - also increased the thrust of the engine by a further 1,000 lbs., allowing more fuel to be carried.

Next stage was to try the airplane out in normal flight. This phase of the test program started on March 13th 1961, clearing the way for the team to cautiously explore the problem of making the transition from vertical to horizontal flight and back again. On some hovering flights, the nozzles were rotated backward to give the aircraft a forward velocity, while during others made from the runway, the nozzles were deflected downwards to allow the aircraft to fly more slowly, eventually bringing it to speeds at which its aerodynamic control surfaces had little effect, control being maintained using the puffer jets.

During a six month series of tests using both P.1127 prototypes, the gap between the highest speed attained from the hover, and the lowest achieved in horizontal flight gradually narrowed, until the first transition was demonstrated on 20th September, 1961. For today's AV-8B pilots, this maneuver has become routine - and it's one you'll have to learn to carry out in seconds.

Early in 1961, the NATO allies released a specification for a new supersonic close-support airplane able to operate from rough strips some 200 yards long. Hawker had already started work on a supersonic P.1150 design. Powered by an improved Pegasus engine with afterburning in all four nozzles, this would have been a practical and useful fighter. Unfortunately, its top speed would have been around Mach 1.3 rather than the then-fashionable Mach 2. It was never ordered.

By the end of the year, Hawker Siddeley had drawn up plans for the improved P.1154 — an aircraft which combined the Mach 2.0 performance of the F-4 Phantom with the VTOL ability of the P.1127. To power this, Bristol Siddeley started work on a more powerful engine - the BS.100.

Worried that the P.1127 concept might be abandoned if left to the British, around the end of the year the US suggested that a batch of P.1127 be built to equip a proposed tri-national US/UK/West German trials squadron. Work started on a batch of nine aircraft built to an improved design designated Kestrel. These would have swept wings, and the uprated 15,200 lbs. thrust Pegasus 5 engine, but would still not be able to carry a useful ordnance load.

Britain pressed ahead with the supersonic P.1154, which was intended for use by both the Royal Air Force and the Royal Navy, and even started work on a C-130-sized short-take-off and landing transport aircraft able to support P.1154 operations. It was an ambitious concept, and one which would even strain today's technology, let alone that of the mid-1960s. In practice, getting the Air Force and Navy to agree on a joint design proved near-impossible, and the commonality between the two versions rapidly dwindled. Late in 1963 the Navy dropped out of the program, and an order for McDonnell Douglas F-4 Phantoms was announced in February 1964.

Work continued on the Air Force version, which was expected to enter service in 1969. The arrival in power in late 1964 of a Socialist Government intent on abandoning most of the nation's military aircraft programmes resulted in both the P.1154 and the Hawker Siddeley 681 STOL transport being cancelled in 1965 before either had flown.

F-4 Phantoms were ordered for both British services, but the go-ahead was also given for the subsonic P.1127 to be taken into service as a combat airplane. It was to use some of the nav/attack systems being developed for the P.1154, and be powered by the latest 19,000 lbs. thrust Pegasus 6 engine. Six development aircraft were ordered in February 1965.

Between the spring of 1965 and the spring of 1966 the Kestrel-equipped tri-national squadron explored the military usefulness of VTOL aircraft, flying around 600 hours for the loss of a single airplane. After the unit disbanded, six of its aircraft were despatched to the USA for trials under the designation XV-6A, while the others stayed in Britain. Flying from the carrier Independence, and the assault ships Raleigh and La Salle, the XV-6A proved the potential usefulness of a naval VTOL fighter.

The first of the six development P. 1127 first flew on August 31st, 1966. A batch of 60 production aircraft was ordered early in 1967, and the first of the resulting Harrier GR.1 aircraft flew on December 28th, 1967. A total of 114 GR.1's were delivered to the RAF, where they remained in service until replaced by the AV-8B Harrier II in the early 1990s.

In 1968 the USMC realised that the XV-6A tests had showed the feasibility of deploying an operational VTOL fighter. Unlike the other US Services, the Marines are an offensive force, one designed to seize and hold beachheads. The fire support they need must travel with them. Marine forces can't take with them the massive artillery support which the Army takes for granted, so strike aircraft must provide the close-support needed to soften up an enemy position, or to break an enemy attack.

In the past, USMC aircraft had operated from carriers, but the P. 1127 Harrier was an airplane which could be deployed from assault ships or even improvised airstrips close to the front line. At first, Congress refused to allocate money for Harriers, but the Marines pressed ahead with their evaluation of the airplane while arguing their case.

When Congress finally did agree to authorise the purchase of 12 Harriers for test and evaluation by the USMC, it insisted that any follow-on order for production aircraft would have to be placed with a US manufacturer. Hawker Siddeley and McDonnell Douglas signed a licence-production agreement for the airplane, while the other deal between Rolls-Royce (who had taken over Bristol) and Pratt & Whitney covered US manufacture of the Pegasus engine. In practice, however, the cost of setting up US production facilities for the planned USMC fleet of 102 single-seaters and eight two-seat trainers was so high that Congress relented, and the aircraft were purchased from Britain.

By now the RAF had progressed from the original Harrier GR.1 to the improved GR.1A (with the Pegasus 102 engine), then the definitive GR.3 (with the 21,000 lbs. thrust Pegasus 103 and additional avionics). The USMC version was similar to the GR.3, but did not have the nose-mounted laser ranger and marked-target seeker fitted to the RAF aircraft. The single-seater was designated AV-8A, with the two-seater becoming the TAV-8A.

A further batch of 13 aircraft was purchased in the early 1970s by Spain. Ordered by the US Navy in order to spare Britain's socialist Government the political embarrassment of selling weaponry to a right-wing regime, they were transferred to Spain where they remain in service as AV-8S and TAV-8S Matadors. They entered service on the elderly carrier *Dedalo*, and now serve on its replacement, the *Principe de Asturias*.

The Marines use the AV-8A in the close-support role, but what Britain's Royal Navy now needed was a VTOL fighter able to operate from the new *Invincible*-class light carriers. Ordered in May 1975, this was based on the GR.3/AV-8A. but incorporated a raised cockpit, a nose-mounted Blue Fox radar, and a marinised Pegasus 11 Mk 104 version of the Mk 103 used to power the Royal Air Force's Harrier GR.3. The Blue Fox radar was designed for the task of detecting high-altitude targets such as maritime-reconnaissance aircraft, and had none of the expensive technology needed for look-down operation against low-level strike aircraft.

First flight of a Sea Harrier prototype was on 20th August 1978. Deliveries to the Royal Navy began in June 1979, and the aircraft became operational in 1980, first on the carrier *Invincible*, then on sister ships *Illustrious* and *Ark Royal*. In its FRS.51 form, it also serves with the Indian Navy, which purchased 23 (plus four two-seat trainers) for service aboard the carriers *Vikrant* and *Viraat*.

Both Britain and the US realised that their existing fleets of AV-8A and Harrier GR. 1/3 would need to be replaced in the 1980s, so the two nations had already started work on studies of a "Super Harrier". In 1973, McDonnell Douglas started preliminary work with British Aerospace (which had absorbed Hawker Siddeley) to develop an improved version of the airplane. The AV-16A would have had a long-span supercritical wing, a 25,000 lbs. (11,350kg) Pegasus 15 engine, and twice the payload/range performance of the existing aircraft.

The two countries were unable to agree on a common design. In the United States, the Marines wanted the most efficient VTOL close-support airplane which technology would permit, but Britain's RAF wanted a design to which its existing aircraft could be rebuilt. Not surprisingly, in March 1975 the British Government announced that there was not enough common ground between the two requirements to justify a joint programme.

At this point, Britain and the US pursued their own national programs. British Aerospace drew up plans for what became known as the 'Big Wing' Harrier. This would have had a revised front fuselage, extended intakes, and a new 34ft (10.4m) span wing of metal construction. Optimised for high-speed flight, this enlarged wing would have been retrofittable to existing aircraft.

In the US, McDonnell Douglas pressed ahead with a less expensive design which would combine a new airframe incorporating refined aerodynamics and the large-scale use of carbon composites with a developed version of the Sea Harrier engine. This would be known as the AV-8B Harrier II.

The cockpit was raised to improve the view back over the inlets and wing - a vital feature in air combat - while a new longer-span wing with 15 per cent more area than that of the AV-8A produced more lift and less drag. The inlets were redesigned, while under the skin, a new generation of avionics promised better reliability. Internal fuel capacity was 50 per cent more than that of the AV-8A. To minimise weight, almost a quarter of the structure was made not from metal but from carbon composite materials.

To speed the programme, the first two YAV-8B prototypes were not built from scratch, but were created by fitting the new wing to two AV-8As. The first flew on 9 November 1978. Flight demonstrations were completed during 1979 with the two prototypes having flown more than 170 test hours successfully.

The aircraft did have problems, but these were political rather than technical. The Carter administration was opposed to the development of an aircraft customised to meet the relatively small Marine requirement. When drawing up the Fiscal Year 1979 Defense Budget Request, the Pentagon refused to add funding for the AV-8B. Instead, it suggested that the Marines buy a batch of 78 McDonnell Douglas A-4M Skyhawks, and increase their order for the F/A-18 Hornet. This would help reduce the unit cost of the latter aircraft, and help keep the Skyhawk production line open. Congress disagreed, and restored funding for the AV-8B.

The following year saw this process repeated, with the Department of Defense refusing the \$203 million requested for continued AV-8B development. Congress forced the release of \$108 million held over from the previous year, and added a further \$180 million for FY80. This allowed a full-scale development contract to be issued in April 1979.

A year later, Congress again over-ruled the Carter administration, and provided not only the \$240.7 million needed for the FY81 development work, but also \$90 million for procurement of "long-lead" production

hardware which would have to be ordered now to allow procurement of the first 12 aircraft.

By now it was clear that the aircraft's long-term future would depend on it's becoming an international program. The obvious customer was Britain. In 1980, the Royal Air Force evaluated the aircraft, and concluded that although the aircraft met the performance standard laid down by Britain's Air Staff Requirement 409 (ASR 409) in most respects, it was badly lacking in one area - maneuverability.

The AV-8B had been tailored to meet a US Marine Corps requirement for an efficient "bomb truck" able to carry a heavier payload over a longer range than had been possible with the AV-8A. In USMC service, the AV-8B would operate under the protection of friendly fighters such as the Grumman F-14 Tomcat and McDonnell Douglas F/A-18 Hornet, but the British wanted an aircraft able to fight in Central Europe, where friendly fighters would be outnumbered by Soviet MiGs.

Any Harrier replacement would have to be able to defend itself, the RAF decided, so ASR 409 placed strong emphasis on maneuverability and survivability for defensive air combat performance. Turn rate of the US aircraft was well below the 20 degree per second turn rate which the RAF thought essential if the Harrier was to be able to defend itself against enemy air-superiority fighters.

As well as identifying the problem, the British also offered a potential solution. The metal wing of the proposed "Big Wing" Harrier - now known as the Harrier GR.5 — would have incorporated wing leading-edge root extensions (LERXs), features intended to increase maneuverability. Studies showed that by adding similar LERXs to the AV-8B wing, the airplane would meet the RAF maneuverability requirement without jeopardising the payload/range requirement needed by the Marines.

In the summer of 1981, the UK agreed to rejoin the programme, and to buy at least 60 AV-8B fighters. British aircraft would be known as Harrier GR.5, the designation originally proposed for the "Big Wing" Harrier. Under the terms of a deal announced in July 1981, the UK agreed to contribute an initial \$80 million to the costs of a joint development program, and to provide the additional \$200 million needed for development work unique to the RAF version.

BAe would set up a production line in England to build the RAF aircraft, and would be responsible for manufacture of the rear and center fuselage sections, center-line pylon and the reaction control system. Fin and rudder assemblies may also be included. Under this work-sharing agreement McDonnell Douglas would manufacture approximately 60 per cent of the aircraft, BAe the remaining 40 per cent. Work on the engine would be split in a similar manner, with 75 per cent going to Rolls-Royce and 25 per cent to Pratt & Whitney.

To keep the existing AV-8A fleet effective until the AV-8B entered service in the mid-1980s, the Marines embarked on a Conversion in Lieu of Procurement (CILOP) program to rebuild existing aircraft to the improved AV-8C standard. Changes included the installation of LIDS (Lift Improvement Devices), plus installation of new avionics such as the AN/ARC-159 radio, KY-28 crypto set, the ALR-45 radar warning receiver, and the ALE-39 flare/chaff dispenser.

The F402-RR-406 Pegasus 11-2IE engine used in early-production AV-8Bs is based on the Mk 104 developed for Sea Harrier, but is designed to match mounting points on the AV-8B airframe. It also incorporates a redesigned fan able to run at higher RPM. It also has new zero-scarf cold nozzles, a revised swan-neck intermediate casing which smooths the flow of air into the high-pressure compressor, a forged combustion chamber, better HP turbine cooling, a new shrouded LP turbine, and improved seals. Maximum thrust is 21,500 lbs.

The first true AV-8B was the first of four full-scale development aircraft. It flew for the first time on November 5, 1981. All four were sent to the Naval Air Test Center during 1982 to begin a program of flight test. The first of 12 pre-production airplanes flew on August 29, 1983. A two-seat TAV-8B version was also developed to help train Marine pilots.

Wherever possible, the AV-8B uses off-the-shelf avionics. Like Marine pilots assigned to fly the AV-8B, you'll have to become familiar with these systems. Prime attack sensor is the Hughes Angle Rate Bombing System (ARBS), a nose-mounted unit which combines a laser spot tracker and TV contrast tracker. This allows day or night attacks to be delivered using conventional bombs, laser-guided "smart" bombs, unguided rockets, or guided missiles such as the Hughes

AGM-65 Maverick. Navigation is handled by an ASN-130 inertial-navigation system.

Harrier GR.3 and the AV-8A had no autopilot, but the AV-8B is fitted with a unit known as the Stability Augmentation and Attitude Hold System. Intended to reduce the pilot's workload by about two-thirds, this allows easier and safer hovering and vertical landings. The pilot can even take his hands off the controls while the airplane is hovering.

Many of the cockpit systems were already used on the F/A-18 Hornet, and include the head-up display (HUD), a multi-function cathode-ray tube (CRT) cockpit display, and an Up Front Control (UFC) panel used for communications, navigation, and weapons control. In the AV-8B cockpit, the engine throttle and nozzles are operated from a single control to allow the pilot to keep his attention focused outside the cockpit during air combat. Under this HOTAS (hands-on throttle and stick) scheme, the pilot will be able to fly 'viffing' (vectoring in forward flight) combat maneuvers. Without looking down, he can control the airplane's maneuvering flaps, select and steer the aircraft sensors, acquire targets, release weapons and aim the guns.

For self-protection, the AV-8B is fitted with an ALR-67 radar-warning receiver designed to detect hostile radar signals. Mounted in the rear fuselage is an ALE-39 dispenser able to release radar-reflecting chaff designed to confuse enemy radars, or hot-burning flares able to decoy heat-seeking missiles. The aircraft is due to receive the internally-mounted ALQ-165 Advanced Self-Protection Jammer (ASPJ), but delivery of this complex system has been repeatedly delayed. (The RAF version of the airplane carries the British-designed Zeus jamming system.) For the moment, the Marines rely on the externally-mounted ALQ-164 jamming pod.

In 1984, McDonnell Douglas started work to create a night-attack version of the AV-8B. This was done by adding a nose-mounted Forward Looking Infra-Red (FLIR) system, and equipping the pilot with Night Vision Goggles (NVGs). These systems are now standard in current production aircraft, while earlier examples will be modified to add these.

The Marines took delivery of their first AV-8B in 1984, and the aircraft became operational with the USMC's VMA-331 Bumblebees in 1985. In

its Harrier GR.5 form, the aircraft became operational with Britain's Royal Air Force in 1989. A total of 94 are planned. Spain ordered 12 EAV-8B to replace the older AV-8A, and these are now in service aboard the aircraft carrier Principe de Asturias.

In its basic form, the aircraft was intended for use by day, but in September 1989 the USMC took delivery of the first version configured for night attack. A similar night-attack version known as the Harrier GR.7 entered service with the Royal Air Force in the following year.

The new avionics needed to give the pilot a view of the outside world were developed in the UK. A nose-mounted Forward-Looking Infra-Red (FLIR) creates an image of the terrain ahead of the aircraft. This is displayed on the HUD as a full-sized image directly superimposed on the outside scene. Flying an aircraft using only the small area visible through the HUD would be difficult, so the pilot also wears night-vision goggles which provide a lower-grade thermal image of the outside world in whatever direction the pilot is looking. This version of the aircraft has a more powerful engine, the 23,800 lbs. thrust Pegasus 11-61, known to the US Marines as the F404-RR-408.

In AV-8B Harrier Assault, you'll be flying this night-attack capable version of the aircraft, the most modern variant currently in service. An even more advanced version known as the AV-8B Harrier II Plus started flight trials on 22 September 1992, but this will not enter service until the mid-1990s. Main change in this new version is a reprofiled nose containing an APG-65 multi-mode radar.

The Marines intend to take delivery of up to 40 AV-8B Plus. Italy plans to buy 15 single-seat and two twin-seat Harrier II Plus for service on the carrier Giuseppe Garibaldi, and could increase this order to around 30. The Spanish Navy expects to operate 12 AV-8B Plus, but will probably rebuild its existing EAV-8B to this standard rather than buy new airframes. Japan is known to be interested in the aircraft.

Production of the AV-8B is expected to run into the early 1990s, by which time the Marines will have taken delivery of 300 AV-8B and 28 TAV-8B trainers. Under present plans, 156 of these aircraft will be built to the night-attack standard. To bring older aircraft up to this standard, the USMC plans a rebuild program. A first phase will install the night-attack avionics; a second could add the APG-65 radar.

Britain will rebuild its Harrier GR.5 aircraft to the GR.7 night-attack standard, but has no plan to add a radar. As part of a mid-life improvement programme, 31 Royal Navy Sea Harriers are being rebuilt to the FRS.2 standard, receiving a British-developed Blue Vixen pulse-Doppler radar able to provide all-weather look-down capability, track-while-scan, and the ability to engage several targets simultaneously using up to four AIM-120 AMRAAM missiles. Other changes include a lengthened rear fuselage (to compensate for the enlarged nose needed to house Blue Vixen), a redesigned cockpit, and an improved radar-warning receiver.

THE REBELLION IN EAST TIMOR

In August 1975 civil war broke out in the colony of Portuguese Timor. The eastern section of the islands which make up the Indonesian archipelago, Timor had first been settled by Portuguese colonists in 1586. In 1859, the island was divided between the Netherlands and Portugal. In 1949, the western (Dutch) portion joined the then-new state of Indonesia, whose independence had finally been recognised by the Netherlands.

For Indonesia, the continued presence of the Portuguese in Timor remained a sensitive issue. Portuguese Timor was run as an overseas province of Portugal, and until 1975 no steps had been taken to promote self-government. Portugal finally decided in 1975 that it would pull out in 1978, and announced plans to hold local elections for a planned People's Assembly.

Unfortunately, the three main political factions in Portuguese Timor were unable to agree as to what form independence should take. The Associcao Popular Democratica de Timor (APODETI) wanted the colony to become an autonomous province of Indonesia, while the Uniao Democratica de Timor (UDT) favored independence but retaining links with Portugal. A third party, the Frente Revolucionario de Este Timor Independente (FRETILIN), wanted total independence.

On August 11th 1975, the UTD announced that it had taken over the colony in a coup. Fighting broke out several days later, and by the 20th had become a full-blown civil war between FRETILIN on one side, and an alliance between the UDT, APODETI and several smaller parties on the other.

By November 28th, FRETILIN was able announce the establishment of a "Democratic Republic of East Timor", but the new state would last for less than a month. On December 7th a force of around 6,000 Indonesian paratroops supported by bombardments from Indonesian warships operating offshore invaded the new republic, and seized Dili, the capital.

Four days later, the United Nations demanded that Indonesia desist from "further violation of the territorial integrity of East Timor" and ordered it to withdraw. Indonesia would admit that its Army was in action, claiming that the attack on DILI had been mounted by APODETI, UDT, and what were described as "Indonesian volunteers."

The formation of a "Provisional Government" for East Timor was announced on December 17th. Four days later, the UN Security Council voted unanimously for a Resolution calling for a total withdrawal by Indonesian forces. This was rejected by Indonesia, which has ignored many subsequent UN Resolutions on East Timor.

By mid-February 1976, the take-over of East Timor was essentially completed. On May 31st the newly-formed "People's Representative Council of East Timor" held a meeting which had only a single item on the agenda - a petition that East Timor be absorbed by Indonesia.

In a ceremony reminiscent of the colonial era, an Indonesian "fact-finding mission" which arrived on June 24th was handed a portion of East Timor soil and a nugget of gold. Five days later, Indonesia announced its acceptance of East Timor, and the existence of the new province was proclaimed on August 17th.

Just over a week later, Indonesian leader Suharto admitted that FRETILIN was still fighting. Two months later, the Indonesian Defense Minister described FRETILIN as a "band of bandits" who would be eliminated in two to three months. In practice, the Indonesian Army was to mount repeated offensives against FRETILIN over the next few years, the largest being in 1978 and the fall of 1981.

1982 produced the first reports of human rights violations by Indonesia, with 4,000 Timorese being held in prison camps on the island of Atauro. By this time, Indonesia estimated that FRETILIN had been reduced to a force of around 130 combatants, while the guerrillas claimed a force of six companies - about 6,800 in total. Independent observers suggested figures ranging from 200 to 600. The province seemed quiet in the first half of 1983, but fighting broke out again that August.

The mid-1980s saw growing reports of further human rights violations - mass arrests, "resettlement programs", the execution of FRETILIN sympathisers, executions during the military operations, conscription of

Timorese civilians into the Indonesian Army. These heavy-handed tactics seem to have worked. On 27th December 1988, Indonesia announced that the FRETILIN rebellion was finally over. Travel restrictions in the area would be lifted, and the region demilitarized.

In October of that year, Pope John Paul II visited Indonesia, and the authorities suppressed pro-Timor demonstrations during his visit. To the Indonesian Government, the most disturbing feature of these demonstrations must have been the relative youth of the agitators, many of whom must have been children at the time of the 1985 invasion. A new generation of Timorese was taking up the struggle for independence.

A program of settling non-Timorese in the region caused protests and demonstrations in 1990. A report by Amnesty International in the following year spoke of an "accelerating program of short-term detention, torture, and ill-treatment of political opponents".

On November 12, troops opened fire in Dili on a crowd of around 3,500 demonstrators. The number killed has never been fully established. At the time, the Indonesian Army claimed 19 deaths, and blamed the incident on a "misunderstood order". Opposition groups estimated the death toll at between 60 and 180. A later official investigation by the Indonesian Government put the figure at 50.

Human rights groups claimed that within days of the massacre, between 300 and 400 people had been arrested, and that between 60 and 80 were executed on November 15. By late November, claims were being voiced that more than 200 had been executed.

By this time, East Timor had been a closed territory for 13 years. Some human rights groups have estimated the number of East Timorese killed or who have died of starvation in the long-running campaign at around 200,000. FRETILIN has offered a cease-fire, but this has been rejected by the Indonesian Government.

The stalemate continues. The rebels lack the strength to defeat the Indonesian Army, but that Army in turn has failed to reduce rebel strength in more than a decade of struggle. If the people of East Timor are ever to be given the chance to decide their own future, this can only be done with the help of the international community.

In 1992, Portugal asked President Bush to apply pressure to Indonesia to persuade that nation to accept the many UN resolutions on East Timor, but with a Presidential election looming and his own poll ratings slipping, there was little, in practice, the US President could do. For the moment, the problems of East Timor remain on the international community's "back burner."