TECHNICAL MANUAL

OPERATOR'S MANUAL

FOR

AH-IS (COBRA) FLIGHT WEAPONS SIMULATOR

HEADQUARTERS, DEPARTMENT OF THE ARMY
20 MAY 1987

CHANGE NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 28 June 1989

OPERATOR'S MANUAL

FOR

AH-1S (COBRA) FLIGHT WEAPONS SIMULATOR

TM 55-6930-213-10, 20 May 1987, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove Pages	Insert Pages
A and B	A and B
i through iv	i through iv
vii and viii	vii and viii
2-3 and 2-4	2-3 and 2-4
--- -	2-4.1/2-4.2
2-5 through 2-8	2-5 through 2-8
2-11 and 2-12	2-11 and 2-12
2-21/2-22	2-21/2-22
4-1/4-2	4-1/4-2
5-3 through 5-5/5-6	5-3 through 5-5/5-6
6-1 and 6-2	6-1 and 6-2
6-5 through 6-8	6-5 through 6-8
7-1 and 7-2	7-1 and 7-2
--- -	7-2.1/7-2.2
7-3 and 7-4	7-3 and 7-4
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- - - -	7-16.1 and 7-16.2
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7-57 and 7-58	7-57 and 7-58
7-105 through 7-108	7-105 through 7-108
Glossary 5 and Glossary 6	Glossary 5 and Glossary 6
Index 1 through Index 8	Index 1 through Index 8

2. Retain this sheet in front for reference purposes.

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

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Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-31, -10 & CL Maintenance requirements for AH-1S Helicopter, Attack.

WARNING

HIGH VOLTAGE

is used in the operation of this equipment.

DEATH ON CONTACT

or severe injury may result if personnel fail to observe safety precautions.

Learn the areas containing high voltage in each piece of equipment.

Under no circumstances should operation of this device be undertaken when cabinets and/or protective covers are removed or open.

WARNING

Motion system operation requires that SEAT BELTS BE USED AT ALL TIMES.

In the cases of runaway motion, immediately activate EMERGENCY STOP switch.

DEATH

or severe injury may result if personnel fail to observe safety precautions.

WARNING

EMERGENCY STOP

Controls are located at each student station control panel and at each instructor/operator console. Depressing this switch shuts down the entire simulator complex.

DEATH

or severe injury may result if personnel fail to observe safety precautions.

WARNING

Sensors that detect heat, lack of airflow, and unsafe mechanical conditions are provided. UNDER NO CIRCUMSTANCES SHOULD THE FLIGHT SIMULATOR BE OPERATED WITH A SAFETY INTERLOCK BYPASSED.

DEATH

or severe injury may result if personnel fail to observe safety precautions.

WARNING

FIRE

Should fire develop, activate EMERGENCY STOP and exit cockpit. DO NOT USE FIRE EXTINGUISHER IN CONFINED COCKPIT.

DEATH

or severe injury may result if personnel fail to observe safety precautions.

WARNING

BOARDING RAMP

May fail to deploy during a power failure. Caution should be exercised when exiting simulator.

DEATH

or severe injury may result if personnel fail to observe safety precautions.

WARNING

Releasing trainer from freeze condition with incorrect rotor rpm may cause motion surges.

DEATH

or severe injury may result if personnel fail to observe safety precautions.

WARNING

LASER RADIATION

Exposure to direct or reflected laser beams may result in

LOSS OF SIGHT

or serious injury if all safety precautions are not followed.

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE : The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by change legends.

Dates of issue for original and changed pages are:

Original . . . . . 0 . . . 20 May 87
Change . . . . . 1 . . . 28 June 89

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 224 CONSISTING OF THE FOLLOWING:

Page No.	*Change No.
a through c	0
d Blank	0
A and B	1
i and ii	1
iii	1
iv through vi	0
vii	1
vii through x	0
1-1	0
1-2 Blank	0
2-1 through 2-3	0
2-4 and 2-4.1	1
2-4.2 Blank	1
2-5	0
2-6 through 2-8	1
2-9 and 2-10	0
2-11 and 2-12	1
2-13 through 2-20	0
2-21	1
2-22 Blank	0
3-1 through 3-3	0
3-4 Blank	0
4-1	1
4-2 Blank	0
5-1 through 5-3	0
5-4 and 5-5	1
5-6 Blank	0
6-1	1
6-2 through 6-3	0
6-4 Blank	0
6-5	0
6-6 and 6-7	1
6-8	1
7-1 through 7-2.1	1
7-2.2 Blank	1
7-3 and 7-4	1
7-5 through 7-14	0
7-15 through 7-16.2	1
7-17 through 7-19	1
7-20	0
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7-22 through 7-27	0
7-28	1
7-29 through 7-37	0
7-38	1
7-39 through 7-56	0
7-57	1
7-58 through 7-104	0
7-105	1
7-106	0
7-107	1
7-108 through 7-110	0
8-1 through 8-25	0
8-26 Blank	0
9-1 through 9-4	0
Glossary 1 through Glossary 5	0
Glossary 6	1
Glossary 7	0
Glossary 8 Blank	0
Index 1	1
Index 2	0
Index 3	1
Index 4	0
Index 5	1
Index 6 through Index 8	1

* Zero in this column indicates an original page.

RECORD OF CHANGES

CHANGE NO.	DATE	TITLE OR BRIEF DESCRIPTION	ENTERED BY
1		CRISP ECP (TSU), NIGHT VISION GOGGLES (NVG) AND G-METER CAPABILITY (ECP-7)	AVSCOM

TABLE OF CONTENTS

NOTE

An alphabetical index is located at the back of this manual. The introduction (Chapter 1) explains the material covered in each section.

Section/Para Page

LIST OF ILLUSTRATIONS

LIST OF TABLES

SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must at all times observe all safety regulations. Do not replace components or make adjustments inside the equipment with the high-voltage supply turned on. Under certain conditions, dangerous potentials may exist when the power control is in the off position, due to charges retained by capacitors. To avoid casualties, always remove power and discharge and ground a circuit before touching it.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances should any person reach into or enter the enclosure for the purpose of servicing or adjusting the equipment except in the presence of someone who is capable of rendering aid.

RESUSCITATION

Personnel working with or near high voltages should be familiar with modern methods of resuscitation. Such information may be obtained from the Bureau of Medicine and Surgery.

WARNING

Alert student pilot and student gunner to clear all controls prior to initialization. Abrupt movement of controls by the computer may cause injury. (Page 7-9) (Page 7-33) (Page 7-43)

WARNING

Care should be exercised when exiting the simulator during power failure. The boarding ramp may fail to deploy. (Page 9-2)

WARNING

Prior to the activation of motion, all occupants of the simulated cockpit and Instructor Operating Station (IOS) (limited to three persons per flight compartment) are required to fasten seat belts. (Page (9-3)

WARNING

Do not discharge a CO_2 fire extinguisher in the confined cockpit. (Page 9-4)

CAUTION

To avoid any possibility of visual system damage, notify visual personnel of the off-line status. (Page 7-27)

CAUTION

Avoid prolonged engagement (in excess of 3 to 5 seconds duration) of HOSTILE GROUND FIRE **switchlight** to avert system damage. (Page 7-29)

CHAPTER 1

INTRODUCTION

1-1. SCOPE . This operator's manual contains complete operating instructions and procedures for the flight weapons simulator (FWS) system for the AH-K modernized Cobra helicopter. This manual is primarily for use by an instructor/operator for the training of pilots and/or gunners in the techniques involved for all normal and emergency flight, tactical maneuvers, and weapons delivery of the helicopter.

1-2. GENERAL . The FWS consists of two operational flight simulator compartments (pilot and gunner), each having a six-degree-of-freedom motion system. Each cockpit is equipped with a visual system that simulates natural helicopter environment. A central computer system controls the operation of the simulator complex. The hardware and software that comprise this complex were designed and built by the Link Flight Simulation Division of the Singer Company, Binghamton, New York.

a. Simulation. The FWS provides normal and emergency procedural flight training and weapons delivery. Additional capabilities include navigation instrument flight operation, day, dusk, and night visual flight operations, and ordnance delivery systems of the attack helicopter.

b. Configuration. The airframe of the helicopter, Army Number 78-23099, equipped with a turbine engine, serves as a basis for simulation and configuration.

1-3. REPORTING OF ERRORS. **Report of errors or omissions and recommendations for improving this publication by the user are encouraged. Reports should be submittedon DA Form 2028, Recommended Changes to Publications, and forwarded direct to Commander, lJS Army Aviation System Command, ATTN:AMSAV-MPSD, 4300 Goodfellow Blvd., St. Louis, Missouri 63120-1798.**

1-4. **ABBREVIATIONS. Nonstandard abbreviations** used in this manual are contained in the Glossary.

CHAPTER 2

SYSTEM DESCRIPTION AND OPERATION

Section I. GENERAL

2-1. OPERATIONAL SYSTEM. The AH-1S FWS is a fixed-base simulation system designed for training in the use of AH-1S modernized Cobra helicopters. Figure 2-1 shows the recommended general arrangement of a portion of the system complex within the Government-built facility. The simulator room where training is conducted, consists of two instructor/crew stations equipped with visual display systems. Each station is mounted on a six-degree-of-freedom hydraulic motion system and controlled by a central computer system. The basic areas of the simulator complex are further described in the following paragraphs.

2-2. SIMULATOR COMPARTMENTS. The simulator room contains separate flight simulator compartments for individual training of pilot and gunner. Each simulator compartment houses a cockpit station and an instructor/operator station (IOS). The cockpit stations are located in the forward portion of their respective flight compartments. Each flight simulator compartment includes visual, motion, and sound simulation. The pilot and gunner can train either in independent modes of operation with separate and unique flight conditions, or in an integrated mode with common training conditions.

a. The pilot station is a replica of the aircraft pilot position and includes facsimiles of the cockpit window arrangements. The pilot seat, main instrument and control panel, flight controls, helmet sight subsystem, head-up display, and left and right equipment consoles are actual aircraft type parts.

b. The gunner station is a replica of the aircraft gunner position. Actual aircraft cockpit equipment includes the main instrument and control panel, left and right equipment consoles, flight controls, seat, helmet sight subsystem (HSS), and telescopic sight unit (TSU).

c. All controls, indicators, and panels operate in a simulated condition and are identical in appearance as those in TM-55-6930-236-10, Operator's Manual for AH-1S Modernized Cobra Helicopter (current change level 3).

d. Three pairs of loudspeakers in each simulator compartment provide realistic aural cue sounds with characteristics correct in respect to location, frequency, and loudness (within limits of safety). Aural cue sounds can be varied in loudness by the instructor/operator.

e. The cockpit seats can be vibrated to simulate the continuous and periodic oscillations and vibrations experienced by the crew during flight conditions and maneuvers. Vibrations representing progressive malfunctions are also simulated. Seat vibration is isolated from the remainder of the simulator station by means of damping elements in the seat mounting construction.

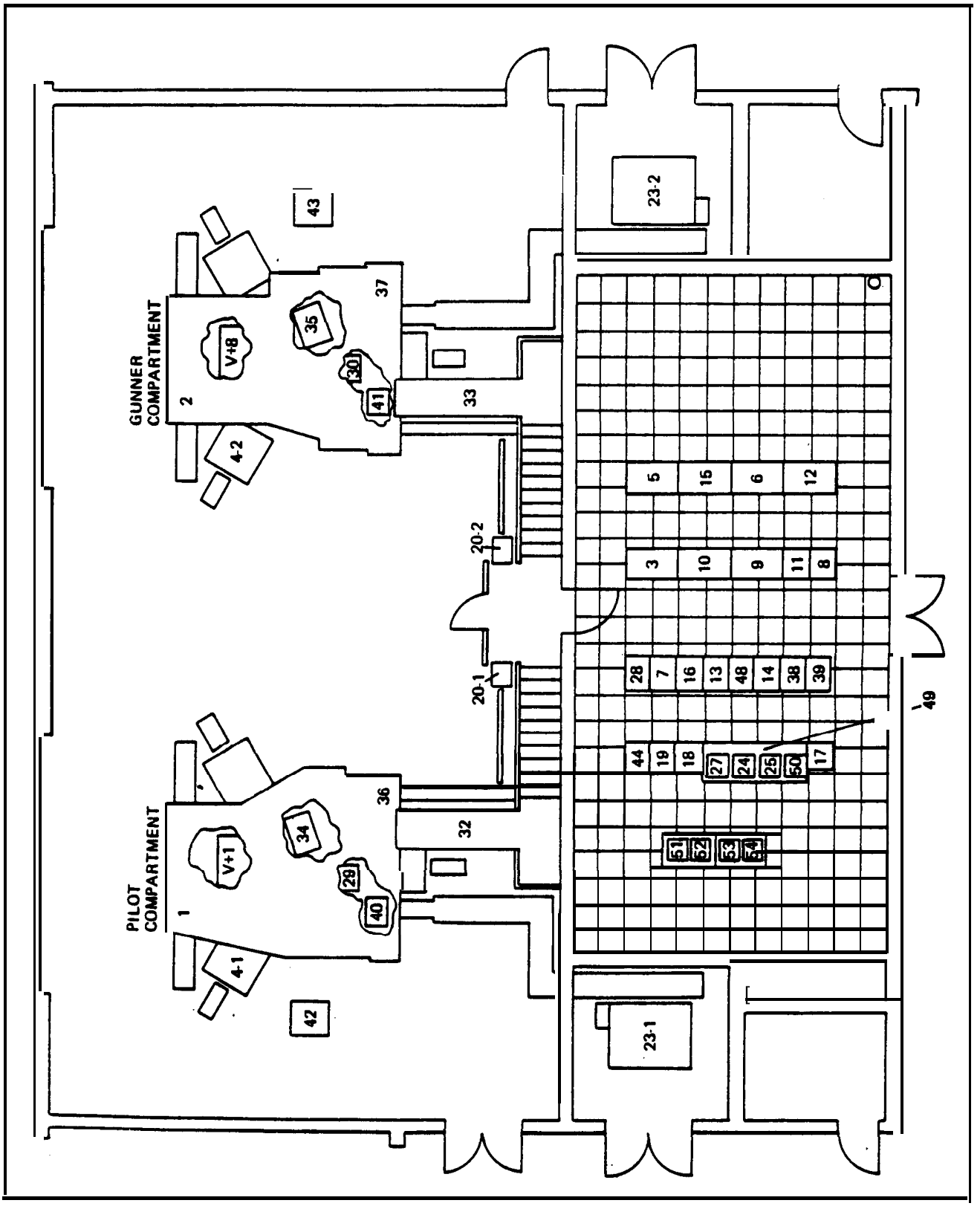


Figure 2-1. Typical Simulator and Computer Rooms of System Complex

f. The ambient temperature of the flight simulator compartment and the cockpit is controlled by adjusting the thermostat located on the back wall of the compartment. Conditioned air is ducted through the compartment area and the normal helicopter cockpit heating and defrosting ducts. The cockpit environment control system switches and controls are nonfunctional.

g. A platform step is provided alongside each cockpit to facilitate entrance and exit. Low-level step lighting for the IOS is provided for safety and is a function of the simulator power. The step lights are controlled by a wall switch at the right compartment door.

2-3. INSTRUCTOR/OPERATOR STATIONS. The IOSs are located adjacent and to the rear of the cockpit in each simulator compartment. (Refer to Section II for further details.) The IOS allows instructors to control the training program and effectively monitor and evaluate pilot/CPG performance. During training, the pilot and gunner IOS function in either independent or integrated modes of operation, with the pilot IOS having overriding control in the integrated mode.

2-4. MOTION SYSTEM. Each simulator compartment is mounted on a six-degree-of-freedom motion system consisting of a moving platform assembly driven and supported from below by six identical hydraulic actuators. The motion system is capable of providing cues for pitch, roll, yaw, lateral, longitudinal, and vertical movements. System motion can be either independent (without simultaneous motion in any other degree of freedom) or in any combination desired to produce real-time dynamic motion cues.

a. Flight simulation includes combined motion representing changes in aircraft attitude as a direct result of flight controls input, rough air and wind, changes in aircraft weight and center of gravity resulting from fuel consumption or weapon and ammunition depletion. Also, motion effects such as blade stall, blade imbalance, damping failure, blades out-of-track, and touchdown impact can be produced.

b. The computer-controlled simulation program causes the motion system to respend realistically to aerodynamic forces and moments within the mechanical limits of the system. All motions except pitch are imperceptibly washed out to the neutral position after the computed accelerations have reached zero. Pitch attitude is maintained as necessary to simulate sustained longitudinal acceleration cues. Acceleration onset cues are scaled as large as possible to fully utilize the range of motion capabilities of each degree-of-freedom.

c. Depending on the particular flight program, the motion system responds to computer input signals as noted in the following examples:

(1) Ground conditions. The motion system provides the vibrational indications appropriate to motion of the aircraft during startup. The system produces a random, low-frequency, low-amplitude, multidirectional oscillation with reasonably abrupt application. The computer simulation program varies the amplitude of oscillation to reproduce the irregularities of less than ideal flight takeoff conditions.

(2) Takeoff and landing. The motion system provides simulated realistic effects for all forms of takeoff, flight, and landing conditions.

(a) During engine runup and initial hover for takeoff, the ground performance of the motion system is as described in paragraph (l). The motion system maintains an attitude appropriate for hover and provides the correct indications of takeoff. Appropriate motion effects occur as a result of changes in acceleration and lift during transition to forward flight.

(b) Similar effects are reproduced during the landing phase. The motion system causes appropriate longitudinal, vertical, and low-frequency vibration effects to occur as in the helicopter. The motion system correctly reproduces the landing impact according to the existing aircraft attitude and vertical and sideslip velocities. When the vertical momentum is greater than the absorption capabilities of the landing skids, landing bounce is simulated.

(3) Normal flight. The motion system correctly simulates the complex and repeated cues occurring during maneuvers associated with normal flight conditions. The random introduction of varying degrees of turbulence produces the appropriate motion effects of small variations in yaw and roll, climb or descent, and airspeed. Superimposed upon the flight maneuver motions is the background motion. The motion system provides characteristic periodic oscillations of the aircraft, lateral instability, and aircraft vibrations up to a maximum of 5 cycles per second. Continuous higher frequency vibrations are simulated using the seat shaker in lieu of the motion system.

(4) Abnormal flight. The motion system correctly reproduces the effects of rotor out-of-track failures. The seat shaker provides cues to out-of-balance. The motion simulated includes the effect of momentary incorrect control inputs as well as conditions appropriate to malfunctions. An aircraft hydraulic system failure resulting in abnormal directional control of the aircraft is provided by appropriate motion cues. High airspeed characteristics and trim change effects are also produced by the motion system.

2-5. VISUAL SYSTEM. The pilot station is provided with forward and left side window visual displays. The gunner station is equipped with a forward window display only. (Refer to Chapter 6 for visual systems details.)

2-5.1 TELESCOPIC SIGHT UNIT. The student gunner station is equipped with a telescopic sight unit (TSU). The optics in the TSU tube are directed toward a CRT located in front of the cockpit. The video image for the CRT is developed by the computer reconstructed images from scene photographs (CRISP) system. Three types of image are provided: a realistic, high-detail, visible spectrum scene; a realistic forward-looking infrared (FLIR) scene: and a simplified symbolic scene. The high-detail scene is commonly referred to as the CRISP scene: therefore, the three scenes are referred to as CRISP, FLIR, and symbolic.

a. The CRISP scene is based on actual photographs of the model board that have been digitized and stored in the CRISP system on a laser disk storage device. This process allows a high-detail, full-color video image to be displayed in the TSU. Because of limited computer memory and processing capabilities, only specific areas of the model board have been photographed and digitized for the CRISP. These areas are referred to as target engagement points (TEP's).

b. The boundaries of a TEP can be visualized as a 50-foot vertical cylinder with a 5-meter radius, the center of which is located at particular coordinates on the model board. Selecting a TEP on CRT page 20 activates the CRISP mode. If CRISP mode is selected and the simulated aircraft position is within the boundaries of the TEP, the TSU displays a CRISP image. If the same conditions are met and the FLIR is turned on, the TSU displays a FLIR image. If the simulated aircraft position is outside the boundaries of the TEP or the CRISP mode is deselected (a TEP selection of 0), the TSU displays a simplified symbolic imagery.

c. TEP's are set up with 84-degree fields of view. The aircraft is able to change heading and altitude allowing the student pilot and gunner to find and track moving targets in the TSU.

d. When CRISP mode is selected, a mask feature can be selected on CRT page 21. If the aircraft is in a TEP, the mask simulates a wall that is 20 meters in front of the aircraft and 5 meters below the TEP center. Students can practice attacking from behind this wall.

e. The CRISP and FLIR scenes show realistic moving targets based on photographs of models. The instructor/operator selects CRISP mode, a TEP, and a target of interest (TOI) that can be seen from that TSP. The instructor/operator then selects one of two predetermined target paths and target velocity and initiates target motion.

f. A smoke screen feature can be selected on CRT page 61. This simulates the release of 15 smoke canisters by the current target of interest. This feature is not available for targets 19 and 20, both of which are HIND's.

g. The symbolic scene shows simplified representations of the targets, horizon, and flat terrain. If the simulated aircraft positon drifts outside the limits of the TEP, the CRISP image automatically switches to symbolic image. Continuity between the CRISP target position and the symbolic target position is maintained even when the TOI is moving. If the CRISP mode is deselected, the instructor/operator selects a heading for the moving target rather than a pathway.

h. IOS repeater monitors allow the instructor/operators to see the same image that is displayed in the TSU. (See figure 2-4.)

2-6. COMPUTER SYSTEM. The computer system consists of five Digital Equipment Corporation PDP-11/55 computer systems with associated memory and peripheral units. The operational software consists of an executive program and real-time simulation programs. The real-time programs, in conjunction with the appropriate hardware, provide simulation of flight performance, engine and related systems, aircraft accessory systems, radio communication and navigation equipment, atmospheric conditions, flight control systems, and malfunctions.

Section II. INSTRUCTOR/OPERATOR STATION DESCRIPTION

2-7. GENERAL DESCRIPTION. Each IOS accommodates one instructor and an observer. Figures 2-2 and 2-3 indicate the arrangement of the instructor/operator stations and their relationship with the cockpit stations. The IOS are designed to permit close, direct contact between instructors and crew. The location of the left and right IOS consoles provides convenient control of each or both cockpits, and direct contact with the CRT displays of information required to monitor, guide, and evaluate pilot/gunner performance. A brief description of the various features of the instructor/operator areas is described in the following paragraphs.

2-8. IOS CONTROL PANELS. Figure 2-4 shows the general layout of the IOS and also the left and right IOS console control panels. The layout of the gunner flight compartment is nearly the same except for the cockpit and a few IOS controls. Panel layout is such that maximum efficiency and ease of controlling any training situation is ensured. A single CRT is provided with a 2-page memory so that the instructor can switch between two pages relevant to a particular training situation. The CRT console can be rotated and locked to three positions to provide optimum viewing angles for the instructor. Ongoing problem controls and displays are, in general, assigned to one page of display memory, while basic simulator controls are relegated to the other page. Related CRT display controls are located on the raised panel to the right of the CRT. Problem flight characteristics and problem controls are located to the left of the CRT. Simulator setup and communications controls are located on the left IOS console. Only minor differences exist in the control labeling and functions between the pilot and gunner instructor panels.

2-9. PILOT/GUNNER CONTROL PANELS. The pilot control panel is located along the outer edge of the left side canopy rail. (See figure 2-2.) The gunner control panel is located along the outer edge of the right side canopy rail. (See figure 2-3.)

2-10. INSTRUCTOR SEATS. The instructor/operator seat is mounted on a track to allow forward or rearward adjustment for optimum positioning. The seat also has a 360-degree swivel capability as well as up and down adjustment to enable the instructor to adjust for optimum CRT and/or cockpit station instruments viewing angle. The seat back incline angle and the armrests are also adjustable. Positive locks in the track, swivel, and height systems prevent the seat from moving in response to motions of the flight simulator compartment. The normal position of the seat places the instructor’s eye level slightly above and to the right of the pilot/gunner eye level in order to permit easier surveillance of the cockpit instrument and control panels.

2-11. OBSERVER SEATS. A fold-down observer seat, equipped with an abdominal seat belt, is located on the back wall of the simulator compartment. It is permanently mounted and nonadjustable, but positioned to facilitate overall viewing of instructor/pilot or gunner performance. An intercommunications system (ICS) panel, consisting of a headset jack, volume control, and a cord of sufficient length so as to be noninterfering, provides observer communication with the instructor/operator.

2-12. IOS AREA LIGHTING. The left IOS console is provided with a variable low-intensity, fluorescent, recessed panel light to provide ambient illumination during any phase of the training. Several of the left and right IOS control panel switches are backlighted to facilitate identification.

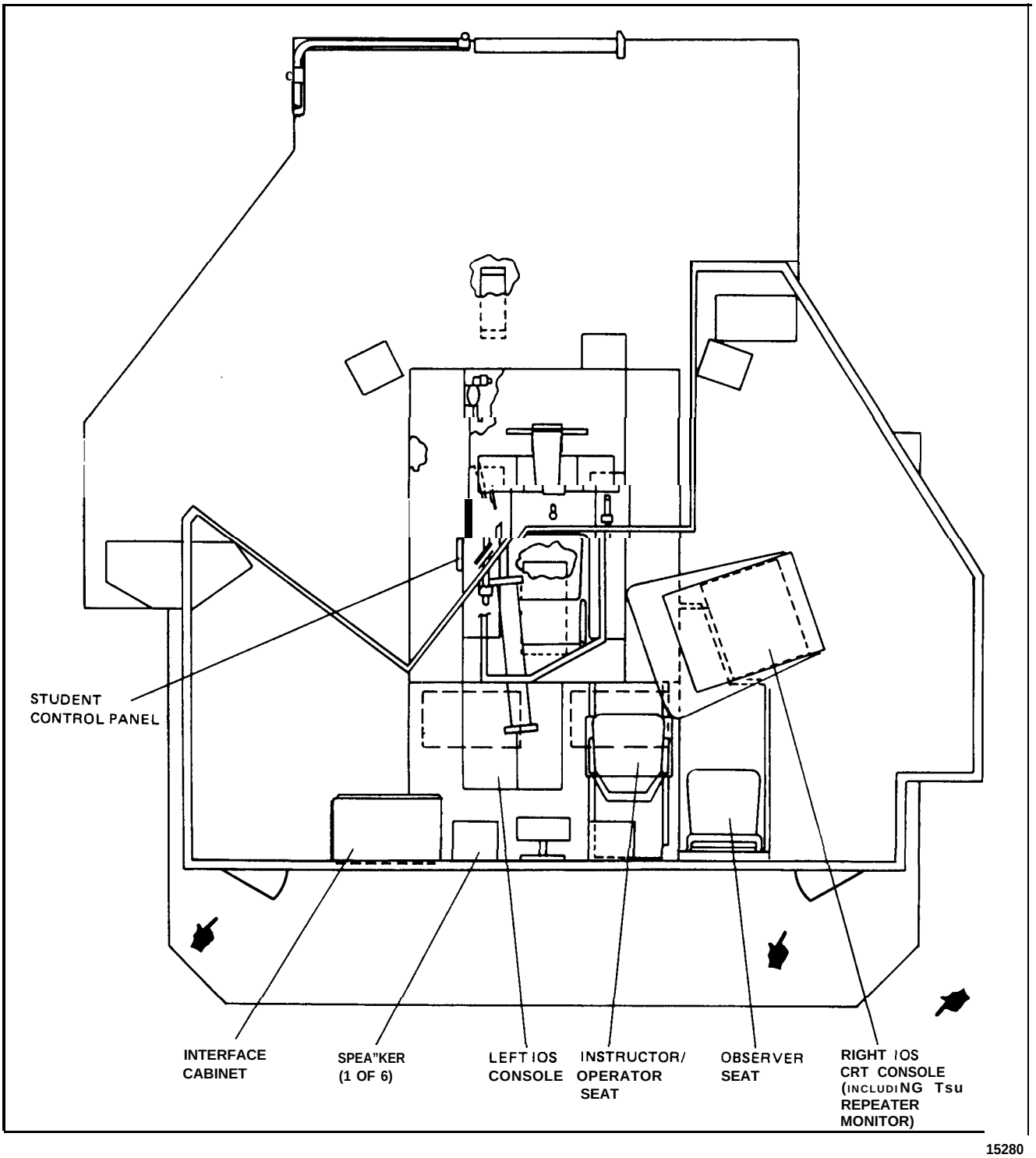


Figure 2-2. Pilot Flight Simulator Compartment

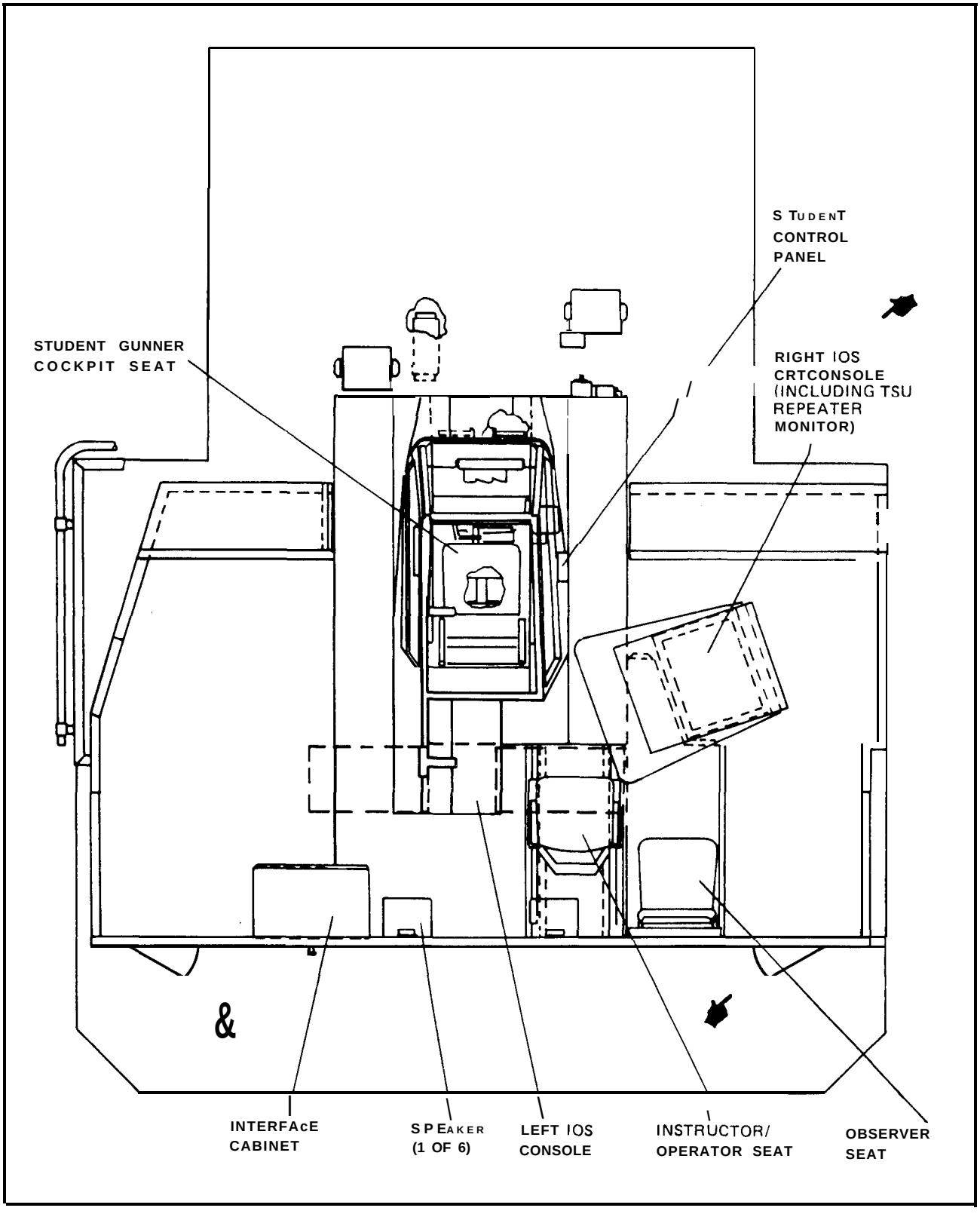


Figure 2-3. Gunner Flight Simulator Compartment

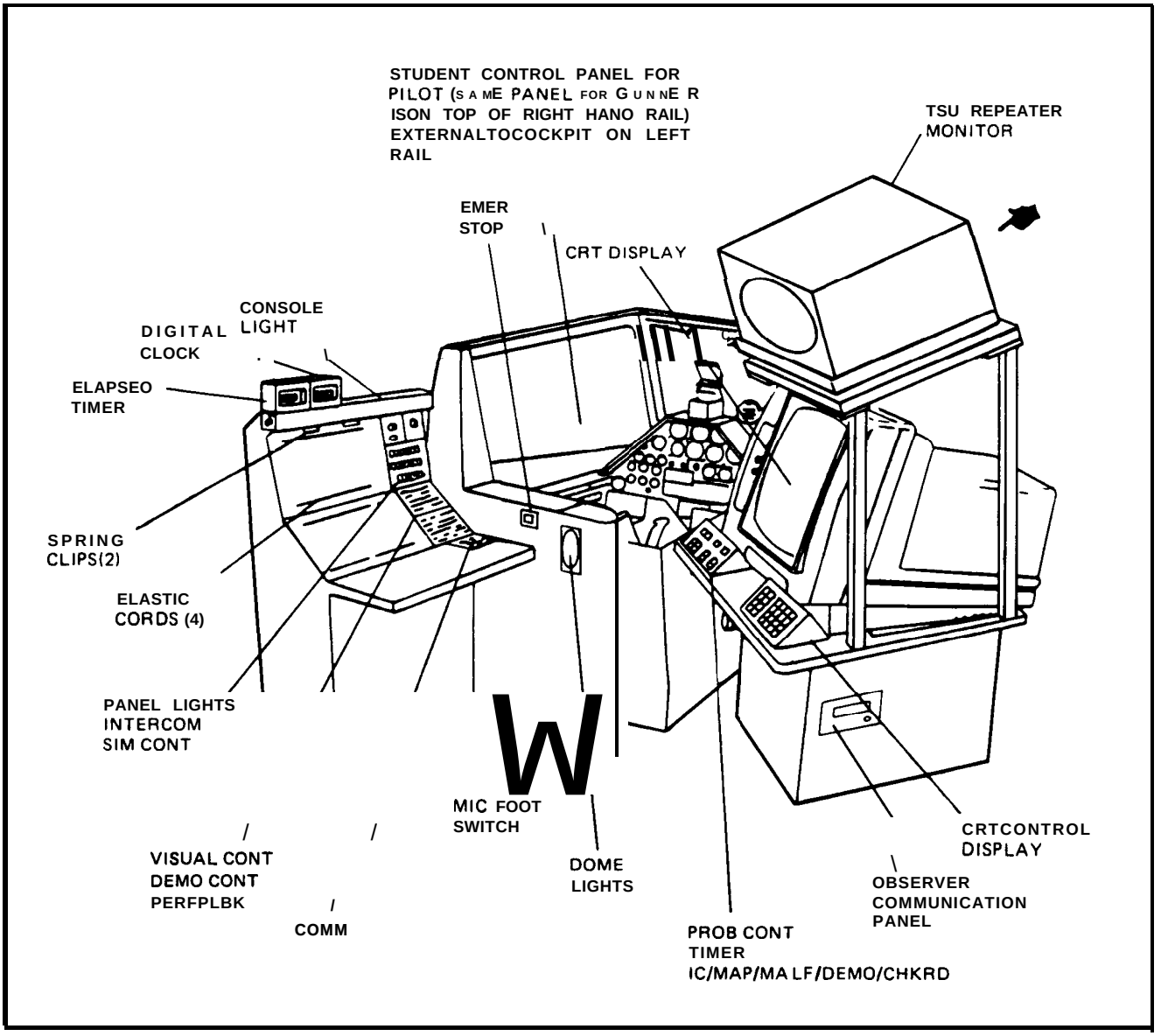


Figure 2-4. Instructor/Operator Station General Layout

2-13. INSTRUCTOR INTERCOMMUNICATIONS SYSTEM. Headset cords and microphone footswitches for each instructor are installed to permit minimum interference with the training function. Communication on a private basis is provided for instructors, observers, and the computer room. A visual warning cue is provided for the instructors, and an aural warning cue is provided in the computer room.

2-14. WORK SURFACE. The left IOS console has a large illuminated area provided for placement of maps, procedures, etc., which can be affixed beneath the elastic cords. Just below, a 10-inch-deep writing/working surface is provided.

2-15. TIME REFERENCES. A digital readout time-of-day clock is located on top of the left IOS console. An adjacent second digital readout clock with front panel controls provides elapsed time measurements.

Section III. MODES OF OPERATION

2-16. GENERAL. The FWS can operate on-line in three categories: training, checkride, and demonstration. The FWS is used in the training and checkride categories with the visual displays and motion system in operation. With two separate visual systems, both cockpits can have their own dedicated forward visual display, or the pilot cockpit can have both forward and left side visual whenever the gunner cockpit is either not using through-the-window visual or is using the same forward visual as the pilot. The pilot or gunner cockpit can either be operated independently or both can be operated as on a single integrated mission as crewmembers of the same aircraft. Training cannot be conducted when the FWS is operating to set up or edit a demonstration. Formulation of a demonstration involves recording and storing in the computer memory the characteristics of particular flight or mission profiles. An accompanying audio commentary can also be recorded and synchronized to the motion. During playback of a recorded demonstration for training, the FWS flies itself through an established mission exercise in a hands-off-the-controls condition. As the simulator reflies the mission, all motion, aural sounds, instrument indications, and visual display scenes are recreated. This can show the pilot and/or gunner standard or particular maneuvers or special flight problems. (Further information on the AH-1S demonstration category is given in Chapter 8 of this manual.) The system features available to each cockpit for the modes of both independent and integrated operation are outlined in table 2-1.

2-17. TRAINING. The administration of training to individuals occupying the pilot or gunner cockpits is under the positive control of the instructor/operator. For either integrated or independent modes, the instructor/operator can employ integrated or pilot independent checkrides with automatic performance recording, prerecorded demonstrations, initial conditions, preprogrammed malfunctions, or other aids through the use of controls and CRT displays provided at the IOS. Information to be displayed at the IOS is updated continuously during the training program to reflect current status.

a. Independent Training. In the independent mode, each instructor/operator is free to control any of the manual features of the simulator. This includes inserting own cockpit malfunctions, changing initial conditions, weapon loading configurations, and selection of nav/comm equipment and facilities. In addition, a training session can be frozen, and from 1- to 5-minute dynamic playback of the current transpired flight conditions is available for review. Nav/comm facilities cannot be failed by the gunner instructor.

b. Integrated Training. In the integrated mode, the administration of training to the crew in both cockpits is under the positive control of the pilot instructor. The pilot instructor controls the manual features of the simulator. This includes inserting malfunctions, changing initial conditions, selection of nav/comm equipment and facilities, and all aspects of training. The gunner instructor generally acts as an observer and has use of only the emergency controls, hardcopy requests, timer, and CRT display select (without editing capability). All aspects of training in the integrated mode can be accomplished without a gunner instructor present.

Table 2-1. Integrated/Independent Operation Features

	Integrated		Pilot Independent		Gunner Independent
a.	Recording or editing a demonstration.	a.	N/A	a.	N/A
b.	Demonstration playback – preprogrammed audio, slow-time, and pause.	b.	Automated flight with preprogrammed audio, slow-time, and pause. System will not respond to student control inputs.	b.	Automated flight with preprogrammed audio, slow-time, and pause. System will not respond to student control inputs.
			NOTE If both pilot and gunner select the same demo, the first cockpit selecting the demo receives audio, audio is not available to the other cockpit while in use by the first.		
c.	Checkride exercise – with audio briefing and performance monitoring of exercise.	c.	Checkride exercise - with audio briefing and performance monitoring exercise.	c.	N/A
d.	Dynamic recording/ performance playback – with audio (no audio in slow-time).	d.	Dynamic recording/ performance playback - with audio (no audio in slow-time).	d.	Dynamic recording/ performance playback - with audio (no audio in slow-time).
e.	Program variation and controls -	e.	All	e.	All except nav/ comm fail facilities and threats.
	Malfunctions				
	Initial conditions		PILOT		
	Zeroing		IOS		
	Environmental conditions		ONLY		
	Nav fail				
	Parameter freeze				
	Problem freeze				
	Refuel/arm				
	Threats				
	Hardcopy		BOTH		
	Timer		IOS		
	Display select (No edit)		GUNNER IOS		
f.	CRISP fixed or fly mode.	f.	N/A	f.	CRISP fixed mode only.

2-18. CHECKRIDE. In the checkride category, automatic performance recording and error scoring programs are employed under software program control. Preprogrammed aircraft flight conditions of visual, instrument, tactical visual, and tactical instrument checkride exercises are administered to the crew(s). The pilot instructor/operator can select either of the checkrides. Any of several subexercises within each checkride can be selected during independent or integrated operation. The checkrides are not available separately to the gunner instructor. However, the gunner instructor could be in the simulator to observe techniques and procedures during the integrated checkride. Once initiated, a checkride program continues in segments until the checkride is completed or until a situation develops from which the crew cannot continue the checkride (e.g., the Simulator crashes or is way off course). During the checkride, the instructor is able only to select and view different pages, maps, etc., and is not able to edit anything. The instructor can. however, advance segments, inhibit malfunctions during exercises, or terminate the checkride at any time. Provisions are made to allow for resumption of the checkride following a manual interruption by the instructor without repeating the entire flight. Characteristics and performance information displayed at the instructor station is updated continuously during the checkride to reflect the status of the checkride and of the simulated aircraft. Error print summary and snapshot plots of pilot/gunner checkride performance are available from the hard-copy printer/plotter. When training or checkride activities are not in progress and maintenance requirements permit, the computer complex can be used for the development or modification of automated demonstrations and checkride programs. (Refer to Chapter 8 of this manual.)

2-19. DEMONSTRATION . For demonstration playback, the instructor/operator can select any of up to 20 recorded demonstrations. Each demonstration can be further subdivided with up to nine separate maneuvers. These individual maneuvers can be selectively accessed, or they can be rearranged to formulate one mission for playback. Synchronized audio accompanying the demonstration is not available to the pilot or gunner compartment if the other instructor has already chosen the same demonstration with audio. The instructor can delete a demonstration at any point. Maximum length of audio capabilities for each demo is 30 minutes. (Refer to Chapter 8, Section II for demo edit and formulation.)

2-19.1 TSU MODES. The TSU has two basic modes of operation: CRISP mode and non-CRISP mode. CRISP mode is entered when a TEP is selected at the IOS. If a zero is entered for the TEP selection, the TSU is in non-CRISP mode. When CRISP mode is selected, the TSU displays a realistic CRISP or FLIR scene if the simulated aircraft position is within the boundaries of the selected TSP. If non-CRISP mode is selected or the simulated aircraft position is outside the TEP boundaries, the TSU displays a simplified symbolic image. Within the CRISP mode there are two additional modes: fixed mode and fly mode. Fly mode can be selected only when the FWS is operating in integrated mode. In the fly mode, the student pilot is responsible for maintaining the simulated aircraft position within the boundaries of the TEP . In fixed mode, if the aircraft flies within 50 meters of the TEP coordinates, the horizontal position is automatically updated to, and held at, the TEp coordinates. Fixed mode is used primarily with gunner independent mode. It relieves the student gunner of the task of maintaining the horizontal position.

Section IV. TRAINING CAPABILITIES

2-20. GENERAL . The AH-1S FWS is a fully operational flight weapons simulator with separate pilot and gunner simulator compartments. Each has its own six degree-of-freedom motion system, visual system, and instructor station. Each cockpit station duplicates its portion of the actual helicopter cockpit configuration. The FWS simulates, in real-time, applicable normal and emergency aircraft operation with respect to both transient and steady-state flight conditions. Operation of the simulator involves such capabilities as engine performance, flying qualities, weapons systems performance and operation, aircraft systems performance and operation, radio communications and navigation systems performance and operation, environmental effects, nap-of-the-earth operation, and flightpath. Simulation is reflected by appropriate pilot/gunner and instructor station instrument and aural indications, aircraft control reactions, visual cue presentations, and display traces responding to pilot/gunner, instructor, and computer-programmed control inputs. Use of the FWS when the visual and/or motion system is inoperative severely limits training capabilities.

2-21. TRAINING OBJECTIVES. The FWS can be used to provide transition training and proficiency flying and weapons delivery practice. The simulator can be used to train aviators to perform all normal and emergency flight maneuvers, weapons delivery operations, nap-of-the-earth (NOE) flight and navigation, and starting, runup, and shutdown procedures. It is capable of full mission simulation, and it can be used for training of both the pilot and gunner simultaneously on the same mission or independently on different missions. This is accomplished in either integrated or independent operating modes of visual, motion, and cockpit simulation available to both pilot and gunner in any situation. The FWS can also be used for the training of instructor pilots.

a. Basic Maneuvers. Training for the following basic aircraft maneuvers can be conducted:

- Cockpit procedures
- Startup and initial hover
- Hovering flight (including turns)
- Traffic pattern
- Normal takeoff from a hover
- Normal takeoff from the ground
- Normal approach to a hover
- Normal approach to the ground
- Straight and level flight
- Level turns
- Straight climbs and descents
- Turning climbs and descents

b. Advanced Maneuvers. Training for the following advanced aircraft maneuvers can be conducted:

- Maximum performance takeoff
- Steep approach
- Basic autorotation (power recovery and termination with power)
- SCM-OFF (stability and control augmentation system) flight
- Running landings
- High-speed flight

b. Advanced Maneuvers. (- continued -)

High-speed dive (normal)
High-speed dive (steep)
Running takeoff
Night operations

c. Emergency Maneuvers. Training for the-following emergency aircraft maneuvers can be conducted:

Forced landings (normal and high speed)
Autorotative glides and turns
Decelerations
Simulated tail rotor control failure
Simulated hydraulic failure
Transient torque control
Pitch cone coupling failure
Emergency procedures (including emergency shutdown procedures)
Autorotations with turns (power recovery, termination with power, touchdown)
Hovering autorotation
Basic autorotations (power recovery, termination with power, touchdown)
Low-level, flat glide autorotation
Low-level, high-speed autorotation (with power recovery, termination with power, touchdown)

d. Nap-of-the-Earth (NOE) Maneuvers. Training for the following low-level nap-of-the-earth aircraft maneuvers can be conducted:

Low-level navigation techniques
Hovering in and out of ground effect
NOE takeoff
NOE flight
NOE approach
NOE downwind takeoff
NOE downwind flight
NOE downwind approach
NOE navigation
NOE radio procedure
NOE quick stop
Masking and unmasking techniques
Scan and detection techniques

e. Gunnery Maneuvers. Training for the following tactical gunnery maneuvers can be conducted:

Weapons cockpit procedures
Combat sight setting
Diving fire
Running fire
Diving to running fire
Low-level/NOE firing (combat sight setting)
Low-level/NOE firing

2-22. SIMULATION SYSTEM CAPABILITIES. Capabilities of the various areas and systems of the FWS are outlined below.

a. Visual Area Navigation. A simulated area of terrain 256 by 256 nautical miles contains 126 navigation aids (radio stations). The actual terrain represented by the model board is 10.5 by 3.9 nautical miles.

b. Nav/Comm Radio. Navigation and communication radio capabilities are provided in Chapter 3.

c. Tactical Environment. Any of ten different weapon loading configurations listed on CRT Page 060 are available for firing at three targets, one of which may be moving, selected from the 26 targets available. Gun tracer trajectories, folded-fin aerial rocket (FFAR) and tube-launched, optically tracked, wire command link (TOW) missile flightpaths, weapon burnout, and ground impact are displayed.

d. Atmospheric Environment. The simulated environment can be controlled by the instructor to provide variable winds, turbulence levels (light, moderate, severe), temperature, and barometric pressure. Temperature in degrees centigrade and barometric pressure in inches of mercury are displayed on the IOS and are referenced at mean sea level. The indications presented on the cockpit instruments, and as seen by the computer, are pressure altitude and temperature based upon application of standard lapse (2°C/1000 feet).

e. Motion Cues. A six-degree-of-freedom motion base provides motion cues of pitch, roll, yaw, heave, longitudinal and lateral. The simulation is further enhanced by a seat vibration system for both the pilot and gunner seats. The seat vibration system can provide continuous and periodic oscillations" and vibrations experienced during normal and emergency flight conditions, including progressive malfunctions. Both motion and vibration can be selected or deselected at the IOS console CRT.

f. Environmental Sound Cues. Environmental sound cues are available at nine levels of loudness and can be selected or varied at the IOS console CRT.

g. Seat Positions. Each flight simulator compartment provides seat positions for one pilot/gunner, an instructor/operator, and an observer.

h. Special Capabilities. The FWS has some limitations that preclude its utilization for training in certain maneuvers. The most serious limitation is in the area of visual field-of-view required for contact flight. Aircraft airspeed for low-level and nap-of-the-earth flights should be limited to a maximum of 90 knots in order to remain within safe operating limits for low-level flight probe protection. Above 90 knots, the performance of the dynamic software protection is marginal. Invalid crashes may occur, or an impending crash may not be detected. On the other hand, the FWS provides the following unique capabilities that the operational aircraft cannot provide:

(1) Freeze simulator action at any instant.

(2) Initiate a training program at any one of 10 predefined locations within the game environment from which the flight can proceed.

(3) Reset the training program to an initialization point that has been modified.

NOTE

Reset is identical to initialization, indicated by freeze indicator blinking.

(4) Override an impending aircraft crash.

(5) Dynamically record and play back up to previous 5 minutes of a current flight.

(6) Insert up to 5 of 207 malfunctions simultaneously.

(7) Demonstrate prerecorded maneuvers automatically.

(8) Administer VFR, IFR, tactical weapons, and tactical instruments checkrides.

(9) Monitor program progress and pilot/gunner performance.

(10) Freeze flight parameters selectively.

(11) Administer audio briefings automatically.

(12) Stop and abort a program at any time in event of emergency.

(13) Retrieve stored performance data via hardcopy printer/plotter.

(14) Fully control training program from IOS, or limited control from pilot/gunner cockpit station.

(15) View on IOS CRT and/or obtain hardcopy time history plots of airspeed, altitude, and ground track.

(16) Immediately alert instructor/operator of pilot/gunner performance error.

(17) Alter environmental conditions that act on the aircraft.

(18) Compute and display ground-controlled approach (GCA) commands.

(19) Train gunner in absolute safety.

(20) Train pilot and gunner both independently and/or simultaneously.

2-23. VISUAL SYSTEM CAPABILITIES. The full-color visual simulation system, combined with computer-generated visual effects, provides a realistic view of ground and sky conditions to the pilot and gunner. (Additional information on the visual system and its capabilities is contained in Chapter 6.)

2-24. TRAINING TASKS. Training of pilot and gunner is carried out in either integrated or independent operating modes of visual, motion, and cockpit simulation. The task of the pilot/gunner is to become thoroughly knowledgeable with all aspects of the pilot and gunner positions of the helicopter. The instructor task is to maintain complete control of simulated conditions for training and to fully monitor crew performance in all normal and emergency operational aspects of the helicopter.

a. Simulated Aircraft. The AH-1S modernized Cobra, manufactured by Bell Helicopter Company, is a single-turbine-engine? single-rotor, high-performance attack helicopter with a two-man crew seated in tandem, the gunner in front of the pilot. The primary mission of this aircraft is that of an armed tactical aircraft with capabilities including weapons delivery, low-altitude high-speed flight, nap-of-the-earth flight, search and target acquisition, reconnaissance, multiple weapons fire support, and troop aircraft support.

b. Flight Control. The simulated flight can be controlled by the following:

(1) By the pilot in the integrated mode with the gunner acting as gunner only, unless gunner control is selected by the pilot instructor.

(2) By both pilot and gunner in the independent mode, each flying completely separate and independent aircraft.

(3) By the instructor via prerecorded demonstrations in either integrated or independent modes.

c. Pilot/Gunner Tasks. The task of a pilot/gunner in the FWS is to learn, practice, and verify the skills and knowledges associated with the pilot and gunner positions on the actual helicopter. The FWS provides transition training, proficiency flying, weapons delivery practice, and the training of instructor pilots.

(1) Pilot independent mode. The following tasks can be conducted in this mode:

Pilot transitional training
Pilot gunnery training
Instrument procedures
Engine control
Navigation/communication problems
Nap-of-the-earth flight
Emergency procedures

(2) Gunner independent mode. The following tasks can be conducted in this mode:

Gunner transitional training
Gunner aircraft control
Gunner engine control
Gunner training (with manual or automatic aircraft control)
Special emergency procedures

(3) Integrated mode. The following tasks can be conducted in this mode:

Pilot/gunner transitional training
Pilot/gunner gunnery training
Crew coordination in normal flight, emergency conditions, instrument conditions, and weapons delivery
Aircraft and engine control
Navigation/communication problems
Nap-of-the-earth navigation, crew coordination, and gunnery techniques

d. Instructor/Operator Tasks. The task of the instructor/operator is to facilitate and verify learning by the student crew. Instructional and operational functions include:

(1) Selection of mission or lesson plan.

(2) Preflight briefing of students.

(3) Demonstration of proper techniques and procedures.

(4) Observation, monitoring, and critique of student performance.

(5) Evaluation of individual or crew training needs.

(6) Identification of areas that need coaching or more special practice.

(7) Scheduled structuring of subsequent practice.

(8) Preproblem setup of helicopter configuration and position.

(9) Setup and modification of environmental conditions.

(10) Random insertion and removal of simulated malfunctions.

(11) Hardcopy recording of important aspects of student performance.

(12) Monitoring and controlling operational status of simulator.

(13) Serving as an air traffic controller when "appropriate.

e. Automation of Instructional Functions. Many facets of the functions noted above have been automated, thus unburdening the instructor/operator. An additional value of this automation is the standardization it provides. Among the more important features of the FWS in terms of automating instructor function are the following:

(1) Demonstration maneuvers. Prerecorded demonstrations of maneuvers are available to the instructor as training aids to be used to demonstrate certain maneuvers to the pilot and gunner. Autoflight tapes are available to the pilot and gunner instructors in the independent modes to provide the pilot and gunner with tactical flight for gunnery training and problem solving.

(2) Automated standard checkrides. With checkride exercises, the instructor does not have to set or modify initial conditions (aircraft and environment), insert malfunctions, or select scoring and error measurement requirements. These are all accomplished automatically. Separate checkrides are provided for visual and instrument flight, tactical visual, and tactical instrument flight.

(3) Ground-controlled approach (GCA). Proper GCA instructions based on the simulated position are displayed on Page 045 of the IOS CRT. This enables the instructor/operator to simply read them, rather than having to interpret graphic displays.

(4) Automatic briefings. These prerecorded briefings include a description of each checkride and its performance criteria.

(5) Scoring and evaluation. During the checkride exercise, a record is made of the errors during each segment of the checkride. Parameters such as the frequency of deviation of the simulated helicopter systems from predetermined standards and the cumulative time out of specified tolerances are recorded automatically and output in hardcopy form. Other evaluation data is available to the instructor/operator from CRT displays and from direct observation of the crew and their instruments and indicators.

f. Briefing. Briefings prior to training missions can be either prerecorded audio or live. Prerecorded briefings include a description of the checkride problem content to be presented and performance criteria. Such automated briefings can provide the following advantages over live briefings:

(1) They relieve the instructor of one of the less challenging aspects of his job, while ensuring that needed content is presented.

(2) They provide standardization, both in form and content of the briefing. This standardization enhances the subsequent evaluation of crew performance, making the task presented to different individuals truly identical.

(3) They allow the crew to obtain a repeat of part or all of the briefing without being inhibited by the possibility of wasting instructor time.

g. Critique. While critique of crew performance after a training exercise is not automated, it can be based on a comprehensive and standardized set of criteria. Errors made during each segment of the checkride are presented as a frequency of deviation from predetermined standards. Such critiquing is aided by the available hardcopy records of crew performance. Such pictures are often worth the proverbial thousand words of instructor comment. A learning feature that can be most useful in critiquing is the 1- to 5-minute dynamic playback of crew performance. This can be accomplished either in real-time or in slow-time. Another function is the hardcopy plot of graphic displays available at instructor discretion.

h. Cueing. Cueing is sometimes defined as the provision of stimuli, usually of a secondary or faint nature, that guides the crew to the correct response. Such cueing, sometimes called prompting, is of considerable value in programmed instruction. Application of prompts or cues are gradually withdrawn or faded as learning progresses. Cueing has a somewhat different meaning in the context of the FWS. Cues for action are the stimuli normally present in helicopter flight such as: instrument and indicator readings, positions of cockpits controls, aspects of the out-the-window visual scene, cockpit motion and vibration, feel of the controls, and sounds associated with helicopter operations. These cues are simulated with a high degree of realism.

i. Feedback. Feedback to the student concerning the adequacy of the performance is provided in two ways: from the pattern of cues resulting from control reactions in the course of operation of the simulated helicopter, and from the measures of performance that can be made available after a training exercise. Feedback during the exercise is provided by the cueing methods as described above. Feedback after the exercise is provided by the scoring and evaluation hardcopy records.

Section V. SYSTEMS SIMULATED

2-25. GENERAL . The aircraft systems simulated by the FWS are outlined in the following paragraphs. Since each aspect of pseudo real-time simulation employs unique hardware and computer software programs to implement them, simulation details are not provided.

2-26. ACCESSORY SYSTEMS. The following accessory systems to the aircraft that provide operational status to the crew are simulated by software via computer control:

- Auxiliary power unit (APU)
- Engine-fuel
- Engine-oil
- Fuel supply
- Transmission oil
- Power train
- Rotor
- Electrical power system
- Hydraulic system
- Instrument indications
- Weight and balance
- Navigation and communication
- Armament
- Flight controls
- Outside environment
- Day, dusk, or night conditions
- Stability and control augmentation (ScAs)

2-27. SOUND SIMULATION. Analog generation under computer control provides the following sound simulation cues:

a. Aircraft Sounds. The following aircraft sounds are simulated:

- Engine
- Compressor stall
- APU
- Ground reflected
- Main rotor
- Touchdown skid
- Transmission and gear train
- Hydraulics
- Ecu

b. Weapon Sounds. The following weapon sounds are simulated:

- FFAR
- TOW missile
- Universal turret 20-mm and 30-mm automatic gun

2-28. MOTION SIMULATION. An electrohydraulic-actuated 6-post synergistic six-degree-of-freedom motion system under computer control provides the following cues:

- Longitudinal displacement/onset cues
- Lateral displacement/onset cues
- Heave displacement/onset cues
- Roll attitude/onset cues
- Pitch attitude/onset cues
- Yaw attitude/onset cues
- Turbulence effects
- Rotor out-of-track/balance effects

2-29. VIBRATION SIMULATION. An electrohydraulic seat shaker is used to transmit vibrational effects to the students while isolating the effects from other compartment mounted hardware and occupants.

2-30. COCKPIT INSTRUMENTATION SIMULATION. All cockpit instruments and controls simulated are actual modified aircraft instruments. Blue-green lighting compatible with the night vision goggles is provided by floodlights and utility lights. Compatible postlights provide supplemental instrument lighting. The instruments accept outputs from dc analog circuitry under computer control and respond with the desired deflections or rotations. Three basic types of circuitry are used to drive the following classes of instruments: meter movement instruments, servo instruments, and synchro instruments.

2-31. RADIO COMMUNICATION AND INTERCOMMUNICATION SYSTEM SIMULATION. The radio communications, guidance, and intercommunication systems (ICS) simulated are listed and described in Chapter 3.

2-32. MALFUNCTION SIMULATION. There are 199 malfunctions (listed in Chapter 7, table 7-2) available for selection and insertion into the simulator.

WARNING

Flight controls may move abruptly upon system turn-on or demonstration maneuvers. Keep clear of controls until neutral position is reached.

2-33. CONTROL LOADING. The control loading system provides a realistic and responsive feeling to the simulated helicopter flight controls. Electrohydraulic units combined with a mechanical linkage system produce control initiating and reactive forces. Feedback from the simulation computer results in appropriate motions of the aircraft in flight. During a demonstration playback or a dynamic performance playback, the cockpit flight controls are driven by the computer and appropriately positioned in response to the motion of the aircraft.

2-34. ARMAMENT SYSTEMS. Simulation for the following armament systems is provided:

Helmet sight subsystem
Head-up display
TOW missile
Universal turret 20-mm and 30-mm automatic guns
19-tube FFAR rocket launcher
7-tube FFAR rocket launcher

CHAPTER 3

AVIONICS

3-1. GENERAL . Simulation for all onboard avionics equipment utilizes actual aircraft panel hardware backed up by applicable analog and digital processing and driver circuitry all under computer control. Operation of nearly all panel controls and indicators is simulated to depict actual equipment functions. Table 3-1 lists the avionics systems that are simulated in the **FWS.**

Table 3-1. Avionics Systems

Class	Nomenclature	Name
Communications	**C-6533/ARC**	Communications Control Set
	AN/ARC-114A	VHF/FM Radio Set
	AN/ARC-115	VHF/AM Radio Set
	AN/ARC-164	UHF Radio Set
Navigation	**AN/ARN-89B**	Auto Direction Finder Receiver Set
	AN/ARN-123V	**VOR/LOC/GS/MB** Receiver Set
	AN/ASN-43	Gyromagnetic Compass Set
	ID-2103A	Horizontal Situation Indicator
	ID-2104A	Attitude Direction Indicator
	ID-205A	Radio Magnetic Compass Indicator
	AN/ASN-128	Doppler Navigation Set
Radar and Transponder	**AN/APR-39**	Radar Signal Detector Set
	AN/APX-100	**IFF** Transponder Set
	APN-209	Radar Altimeter

3-2. COMMUNICATIONS EQUIPMENT. Simulated radio communications is such that the two-way communication primarily takes place between the **crew** and the instructor(s). At the same time, electronics interfacing with the computer, which defines and controls some of the variables, allows for complete system flexibility. System power controls and indications, aircraft flight parameters, and simulated equipment failure commands are brought into the computer for processing. From this, the necessary commands are then generated for the avionics and system related equipments. The following communications equipment is simulated:

a. **C-6533/ARC** communications control panels, in both the pilot and gunner **instrument** panels, integrate control of the aircraft communications equipment. Selection switches and volume adjustment provide for **pilot/gunner** intercommunication and simulated radio receiving and transmission. Both **IOS** consoles have modified communications control panels that are functionally similar to the student panels but provide additional capabilities. Additional panels are located in the facility computer room and at each observer station.

b. AN/ARC-114A VHF/FM radio set provides a two-way communications channel between the gunner and the instructor/operator. This channel is used for communications on all frequencies of the radio set. The unit also has FM homing capabilities and is used in conjunction with the attitude direction indicator (ADI) and the horizontal situation indicator (HSI) cockpit navigation instruments.

c. TSEC/KY-28 voice security equipment panel, near the middle of the pilot right console, is normally used in conjunction with the AN/ARC-114A to provide security two-way communication. Although this panel is present, it is nonfunctional.

d. AN/ARC-115 VHF/AM radio set provides a two-way communications channel between the pilot and the instructor/operator. This channel is used for communications on all frequencies of the unit.

e. AN/ARC-164 UHF radio set normally provides two-way communications between the pilot and ground-based equipment. Located in the pilot right console, a communications channel is established between the pilot and the instructor.

3-3. NAVIGATION EQUIPMENT. Navigation systems and equipment provide location and course related information to the pilot and gunner via radio receiving links and instrument panel indications. Simulated navigation equipment is as follows:

(a) AN/ARN-89B auto direction finder (ADF) receiver set develops navigational course information from ground-based transmitter sources. This receiver is partially simulated in the FWS and is used in conjunction with the radio magnetic indicator (RMI) and the HSI cockpit instruments, giving aircraft bearing and course information. Indications are based on the station that the receiver is tuned to. An audio tone is produced which varies in loudness depending upon the simulated directional positioning of the aircraft.

NOTE

There is no correlation between the simulated navigation facilities of the real-world environment and the terrain model of the visual system.

(b) AN/ARC-123 VOR/LOC/GS/MB receiver set (VHF omni-range/localizer/glide-slope/marker beacon) enables the pilot to determine present position and direction to a given point, and maintain course on a predetermined flightpath related to a ground-based transmitter. Simulation includes computer-generated signals that provide the appropriate position and direction indications on the HSI and ADI cockpit instruments. An audio tone depicting flightpath is also received from the simulated ground-based transmitter.

(C) AN/ASN-43 gyromagnetic compass system provides the pilot and gunner accurate reference indications of the magnetic heading of the helicopter. Functional control of this system is through the C6347 compass controller panel located in the pilot right console. Directional information is supplied to the HSI and RMI cockpit instruments. System simulation involves the computer and interface circuitry to drive the cockpit instruments providing the directional information based on the simulated positioning of the aircraft.

(d) ID-2103A HSI, ID-2104A ADI, and ID-2105A RMI are pilot or gunner cockpit instruments that provide visual indications of appropriate location, attitude, and course information as determined by the avionics equipment. These instruments are driven directly by the computer via appropriate interface circuitry. In addition, a standby compass in the gunner cockpit, indicating the simulated aircraft magnetic heading, is also driven by the computer and interface circuits.

(e) AN/ASN-128 Doppler navigation set is a self-contained navigation system that operates in conjunction with the aircraft heading and vertical reference systems. Simulated velocity, position, and heading information is presented on the ASN-128 display panel. This is generated by the computer after determining the mode of operation and the related system parameters that are affected by the current conditions of the FWS.

3-4. **RADAR AND TRANSPONDER EQUIPMENT.** The following equipment is limited in simulation to provide status indications to either the pilot or instructor/operator:

a. AN/APR-39 radar signal detector set provides a visual and audio indication to warn the pilot of a potential threat to the aircraft. The control panel, in the pilot right console, is toward the rear. A choice of five different radar threats can be selected by the instructor/operator, and up to three simultaneous warning threats can be displayed on the cockpit instruments.

b IFF transponder set (identification friend or foe) enables the helicopter to identify itself automatically when properly challenged by an external radar system. The control panel is in the pilot right console. Simulation is limited to the status reporting of panel switch positions on the IOS console CRT display.

c. APN-209 radar altimeter is a terrain-tracking and altitude-sensing system. An altitude indication is provided in the cockpit and also displayed on the IOS CRT display-in a scrolling graph form.

CHAPTER 4

TACTICS

4-1. GENERAL . The FWS, having full mission tactical weapons capabilities, enables the student pilot and/or gunner to practice and improve proficiency in missions involving missile and rocket delivery and gunnery exercises. The following armament systems and components are simulated and interfaced with the computer via signal conditioning equipment:

M97 universal turret 20-mm and 30-mm gun
M65 TOW missile
M200 19-tube FFAR rocket launcher
M158 7-tube FFAR rocket launcher
M136 HSS TSU
M76 head-up display (HUD)
M138 rocket management subsystem
M22 fire control computer laser range finder
AN/AAS-32 airborne laser tracker
AN/ALQ-144 infrared jammer pilot armament control panel

4-2. VISUAL SIMULATION. The simulated environment consists of through-the-window displays for the pilot and gunner with the tactical target in the visual scene. Storable targets of opportunity are provided in the visual scene at selected locations in the form of military vehicles or missile launching sites. The display also portrays such weapon effects as gun tracer trajectories, FFAR and TOW missile flightpaths, weapon burnout, or ground impact. The TSU images (CRISP, FLIR, and symbolic) also show weapons effects such as tracers, missiles, and impact. The TSU scene always includes a computer-generated image of the sighting reticle with READY, ATTACK, and GUN flags and laser range finder readouts. The CRISP and FLIR scenes correlate with the through-the-window scenes, the symbolic scene does not.

4-3. TRAINING. To initiate a problem, the instructor/operator enters CRISP mode by selecting a TEP. The instructor/operator then selects a TOI and fixed or fly mode. The instructor/operator may set the simulated aircraft position or direct the students to fly to the TEP location. The student gunner can operate the TSU and/or FLIR controls to locate and fire at a target. The instructor/operator selects one of two pre-defined target paths for the TOI and a target velocity, and then initiates target motion. In non-CRISP mode, the instructor/operator selects a target heading instead of a target path. Weapon loading is then carried out by the instructor/operator by means of IOS console CRT/keyboard action. Ten different weapon loading configurations are available. The current status of remaining armament at each aircraft weapon station can be presented on the CRT and is based on the initial conditions of the weapon loading configuration and weapons previously fired.

4-4. EVALUATION. The instructor is provided with weapon scoring data on a CRT page. The displayed data provides the number of rounds fired, number of hits, an accumulative center-of-mass displayed as distance over or short, left or right, and burst duration where applicable. The aural cue system provides for simulation of normal and abnormal sounds that make up the cockpit acoustic environment. Weapon sounds include: FFAR, TOW missile, and universal turret 20-mm and 30-mm gun.

CHAPTER 5

OPERATING LIMITS AND RESTRICTIONS

5-1. GENERAL . The flight weapons simulator was designed to a high degree of imilarity to the actual helicopter. Since the purpose of the FWS is for pilot transition and gunnery training, certain operations and functions of the aircraft are only partially simulated or not at all. Those operations and functions that follow were determined to have very low or no applicability for the enhancement of pilot and gunner training and proficiency. General items include the following:

Transparent canopy plexiglass is not present.
Canopy removal arm/fire mechanisms are installed but nonfunctional.
Pilot lighting control panel is functional but limited.
Rain removal/heat switch is installed but nonfunctional.
Secondary torque meter and clock cockpit instruments are omitted.

5-2. AVIONICS. Communications equipment provides for instructor and crew communications but not actual signal reception or transmission. Discrete frequency radio communications channels are not available. (Additional limitations that exist with the avionics equipment are described in Chapter 3.)

5-3. TEMPERATURE AND HUMIDITY. The simulator compartments and motion systems are required to operate in a comfort-controlled environment at a temperature of 75 (±10)°F (22 (±6)°C) at a 50 (±5)% relative humidity. The computer complex is required to operate in a controlled environment of 70 (±5)°F (21 (±3)°C) at a 50 (±5)% relative humidity. The visual area is actually three rooms having two separate environmental requirements. The two model rooms are required to operate within a temperature ratnge of 70 (±5)°F (21 (±3)°C) at a 50 (±5)% relative humidity . The laser generating equipment room is required to operate within a temperature range of 73 (±3)°F (22.5 (±2)°C) with a relative humidity of 50 (±5)%.

a. In the course of operation, variations in room temperature must not result in the development of relative humidity above 70% or below 30% at any temperature within the range from 50°F (10°C) to 100°F (38°C). Temperature sensors in the equipment cabinets are capable of sensing two overheat temperatures. At 100°F (38°C), they illuminate a light on the failure indications panel indicating that a particular cabinet location is in an overheat condition. In addition, an aural warning is activated. If the overheating condition is not corrected, the entire simulator complex will be automatically shut down when the temperature exceeds 110°F (44°C).

b. The internal temperature of the pilot and gunner FWS compartments is controlled by separate, dedicated air conditioners ducted at supplementary outlets within the compartment and the normal cockpit heating and defrosting ducts. Separate thermostat controls are provided on the inside rear wall of each compartment. The cockpit air temperature controls, although present, are nonfunctional.

5-4. OCCUPANCY. During simulated maneuvers, safety reasons require that occupancy of each flight compartment is limited to three persons: pilot or gunner, an instructor/operator, and an observer.

5-5. MOTION SYSTEM. For multiaxis motion, the maximum platform excursion values are given below with respect to a forward reference point. These are measured with respect to an origin established when the motion platform is considered to be at a neutral position; that is, with the hydraulic cylinder legs at midposition:

Vertical:	33 inches up, 38 inches down
Lateral:	±58 inches
Longitudinal:	±53 inches
Pitch:	31° down, 36° up
Roll :	±32°
Yaw:	±32°

5-6. VISUAL SYSTEM. The laser visual system generated field-of-view is 48 degrees horizontally and 36 degrees vertically as seen on the cockpit display. Visual flight simulation takes place on a terrain model representing a rectangular geographical area of 24,000 x 64,000 feet (4.0 x 10.6 nautical miles). The instrument gaming area is 256 x 256 nm.

5-7. AUDIO SYSTEM. No briefings are conducted after a checkride exercise is initiated. Once programmed, accompanying audio cannot be turned off while a demonstration continues. Audio is not available during slow-time playback. All aural cues are limited in loudness to within established safe levels or hearing. Sounds associated with rain and hail are not provided.

5-8. IOS CRT CONTROLLABLE PARAMETERS. The CRT display pages provide instructor/operator control for aircraft environment, flight, and miscellaneous related parameters. Selectable values for edit are limited within the range normally found in a realistic world or within the limitations of the actual helicopter.

NOTE

To ensure reliable and valid playback of any dynamic performance recording or playback of a demonstration in either integrated or independent training mode, a limited number of edits to the IOS CRT page parameters are allowed while in a freeze condition. This is due to the amount of buffer memory space allocated for storage of edited parameters. Once the limitation is reached, indicated by a message on the CRT, the simulator must be removed from freeze for a short period of time before more edits can take place.

a. Environmental Conditions. Selections of environmental conditions are limited as follows:

Barometric Pressure	- 27 to 32 inches Hg
Outside Air Temperature	- -50°C to +50°C -58°F to +122°F
Wind Velocity	- 0 to 50 knots
Wind Direction	- 001 to 360 degrees
Horizontal Wind Gust	- 0 to 30 knots
Visibility	- 0 to 60,000 feet
Ceiling	- 0 to 1,850 feet
Cloud Thickness	- 0 to 1,000 feet (see NOTE)
Turbulence Level	- 0 to 9 (state levels)
Day/Dusk/Night	- 1/2/3 (selection)

NOTE

To keep pilot/gunner in clouds throughout flight, place visual in STANDBY; delete STANDBY prior to breakout on approach, etc.

b. Freezable Flight Conditions. During a training exercise, the following aircraft flight conditions are a direct result of the cockpit flight inputs and are freezable only; these conditions are editable during setup of initial conditions:

Altitude	0 -20,000 feet
Airspeed	0 - 190 knots
Heading	001 to 360 degrees
Vertical Speed	-6000 to +6000 feet per minute
RPM	0 to 105%

NOTE

Conditions of roll, pitch, yaw, torque pressure, and rate-of-turn are all interdependent flight parameters that assume in-turn conditions under software control and are neither editable nor freezable.

c. Editable Flight Conditions. Aircraft flight condition editable parameters are:

Fuel Loading	1743 pounds maximum
Latitude	N 090°00'00"
	S 089°00'00"
Longitude	E 180°00'00"
	W 180°00'00"

d. Miscellaneous Conditions. Parameter limits for related conditions are:

Sound Level	0 - 9 (state levels)
Seat Shaker	on/off
Runway Edge Lights	on/off
Runway Pinnacle	on/off
Confined Area Lights	on/off
Airfield Approach Lights	on/off
Airfield Strobe	on/off
Hostile Ground Fire Select	1 - 10
Field Select	1 - 6
Weapon Configuration	0 - 10
Auxiliary Power Unit (APU)	on/off

e. Malfunctions. In either integrated or independent training mode, insertion or deletion of malfunctions is not allowed while in a freeze condition.

5-9. COCKPIT CIRCUIT BREAKERS. Circuit breakers listed below are functional but not poppable:

AC Circuit Breaker Panel:
REF XMPR

DC Circuit Breaker Panel:
FUEL/OIL VALVE
POS LTS
ANTI COLL LT

5-10. ARMAMENT SYSTEM. Armament simulation is implemented so that the instructor must inform the pilot/gunner which weapon load configuration is in effect and that cockpit actions and indications must be compatible. The following conditions and limits exist:

a. The trajectory and impact point display cues are representative only for a maximum aircraft to target-of-interest range of 6000 meters.

b. For the occurrence of simultaneous firing of the FFAR rocket and the 20-mm turret gun, the TSU supports the turret gun fire. Rocket fire is then slightly degraded.

5-11. TELESCOPIC SIGHT UNIT. The TSU has the following limitations:

a. The TSU displays realistic CRISP or FLIR scenes only when CRISP mode is selected and the simulated aircraft position is within the boundaries of the selected TEP. Otherwise, a symbolic scene is displayed in the TSU.

b. When a symbolic scene is being displayed, a maximum of three targets can be displayed.

c. Only one target can be selected as the TOI, and only the TOI can be a moving target.

d. When CRISP mode is selected, target movement is limited to one of two predetermined target paths.

e. When CRISP mode is deselected, the movement of a symbolic target involves horizontal movement in a straight line along a selected heading. The target does not follow changes in terrain elevation that may be present at the corresponding location on the model board.

f. Targets that appear in the through-the-window scene do not move. A spot of light is introduced into the camera-model board image, however, which shows the location of a moving target.

g. The simulated FOV for the FLIR narrow FOV image is slightly larger than the FOV in the actual aircraft. The difference should not be noticeable to the user.

h. CRISP is only available from airfield 2.

Once a TEP is selected, only TOI'S existing for that TSP can be engaged. (See figure 7-13.1.)

j. Visibility effects such as fog should be set up before the training session begins.

5-12. INDEPENDENT MODE. This mode is limited as follows:

a. Demonstrations cannot be dynamically recorded.

b. Only one visual system is available to the pilot if the gunner is using visual. However, selection of front and side visual by the pilot instructor removes visual from the gunner. As a result, no visual is available to the gunner if the pilot is using both front and side visual.

c. No demonstration audio is available if the other cockpit is already using the same demonstration with audio.

d. Instructors cannot initiate malfunctions affecting the other cockpit.

e. The pilot cannot use a moving target.

f. The pilot instructor is required to provide TOW ATTACK SEQ and TOW FIRE inputs to the pilot.

g. The gunner instructor is required to provide MASTER ARM and PILOT HSS inputs to the gunner.

h. No checkrides or exercises are available to the gunner cockpit.

i. The gunner has no radio communications other than ICS to instructor.

j. The gunner cannot affect electronic warfare threat environment.

k. The gunner instructor/operator cannot fail navigation radio facilities.

l. CRISP fly mode cannot be selected. Fixed mode is automatically selected.

m. The TEP can be selected only from the gunner station IOS. I

5-13. INTEGRATED MODE. This mode is limited as follows:

a. The TEP can be selected only from the pilot station IOS.

b. The gunner visual is the same as the pilot front visual.

c. The gunner instructor/operator has no IOS control or editing functions. However, selection of CRT page displays without edit, and motion off, emergency stop, freeze, timer reset, and hardcopy request are available to the gunner instructor/operator.

NOTE

The gunner can unfreeze the simulator only when the pilot IOS-GUNNER CONT switchlight is selected (illuminated).

CHAPTER 6

VISUAL SYSTEM

6-1. GENERAL DESCRIPTION. A full-color laser image generator (LSIG) visual simulation system is provided with the flight simulator. The LSIG visual system greatly enhances training capability by presenting to the student a realistic view of an environmental scene that responds to the simulated operation of the helicopter. There are two separate LSIG systems supplied for the flight simulator complex. They can operate either independently or in common, depending upon the selected system mode of operation.

a. Integrated Mode. In the integrated mode, the visual scene is presented to the pilot with a forward window and a side window display, when selected. Each display provides the appropriate view from the pilot seat. The gunner is provided with a single forward display identical to the pilot forward display. In addition, the gunner is provided with a TSU that displays realistic CRISP or FLIR scenes, or a simplified symbolic image. The realistic scenes correspond to the image in the out-the-window display.

b. Independent Mode. In the independent mode, both front and side displays are available to the pilot, provided the gunner instructor does not have visual selected. When gunner visual is selected, the pilot has visual available in the forward display only. If the pilot instructor has selected FRONT AND SIDE, then visual is not available to the gunner.

6-2. LASER IMAGE GENERATION. The LSIG system employs a multicolored laser beam that scans a high-detail model board within the pilot's field-of-view. As shown in figures 6-1 and 6-2, the laser beam originates at the laser table and is directed along the gantry X-axis. The beam is then transmitted up to the Z-carriage package, where the laser scanning head generates the scanning raster for projection through the probe onto the model board. The scattered, reflected light is picked up by the bank of photomultiplier tubes (PMT's), each sensing the reflected light simultaneously with the others and generating an output signal. The outputs from all the PMT's are then added to produce a composite time-varying video signal as the gantry transport duplicates the flightpath of the simulated aircraft. The video signal is used as an input to the main video processor where the special effects, including visibility and horizon, are inserted. The signal levels are then properly scaled to drive the displays in the cockpit.

6-3. MODEL BOARD. The two LSIG systems contain identical 24-foot by 64-foot vertically-mounted, three-dimensional terrain model boards. Each model board is scaled at 1:1000 to provide a terrain area of 24,000 by 64,000 feet (3.9 by 10.5 nautical miles). Model board scene extenders (mirrors) are used to increase the view available in the cockpit even when close to the edge of the model. Sufficient points of visual reference on the models provide navigation cues consistent with the field-of-view provided. Model features include provisions for NOE flight and a typical staging field. Targets are provided visually in the form of military vehicles and buildings.

6-4. LASER TABLE. A laser table provides the source light for the scanning system. The laser table is designed as a floor-mounted optical bench. The table houses two lasers, one supplying blue and green and the other supplying red; several optical elements such as beam-expanders, beamsplitters, fold mirrors, and cubes; and a test channel containing two monitors. The outputs of the lasers, when combined, produce a single, concentric white light beam. This light beam is transmitted along the gantry to the Z-carriage package containing the scanning head and optical probe. (See figure 6-2.)

6-5. BEAM TRANSMISSION SYSTEM. The concentric white light beam from the laser table is expanded and then routed along the X-axis, up the Y-tower, folded along the Z-axis and into the entrance pupil of the Z-axis scanning head package. The transmitted beam must be shielded against air turbulence effects throughout its path using a beampath enclosure. This is accomplished by utilizing a self-closing arrangement of brushes mounted on an extruded aluminum channel, which in turn is fastened on a U-shaped sheet-metal enclosure.

6-6. LASER SCANNING HEAD. The laser beam is transmitted along the gantry to the laser scanning head mounted on the Z-carriage of the gantry. This is where the actual generation of the scanning raster is accomplished. The laser scanning head is analogous to the TV camera head of the camera model visual system (CMS). A raster corresponding to the display field-of-view (48 degrees horizontal by 36 degrees vertical) is generated by deflecting the laser beam with the high-speed line scanner for the horizontal trace and with a scanning galvanometers for the vertical trace. The laser scanning head is packaged as part of the Z-axis carriage assembly. Rigid optical baseplates are used to mount the major elements in the optical chain. Space is provided on the carriage for mounting the scanner electronics and cooling system. Other support equipment, such as the vacuum pump and air pressure holding tank, are housed in the Y-tower.

6-7. PHOTOMULTIPLIER TUBE (PMT) BANK. The scanning raster from the Z-carriage package is projected onto the model board through the Farrand 60° Scheimpflug probe modified for laser use. The light reflected by the terrain model is then picked up by the PMT bank, generating the video signal for electronic processing and display. Each PMT module in the bank contains three PMTs, each with a color filter to select the red, green, or blue light from the illuminating laser. The light reflected from the model and detected by the PMT's is thus separated into separate video signals analogous to the RGB signals of standard color TV systems. The signals from each module of the PMT bank are then summed in parallel to form the composite video for the displayed image.

6-8. IMAGE CORRELATION. The LSIG projects an actual scanning raster onto the terrain model board. In effect, the picture details are addressed by the laser beam, one picture element at a time, as it scans across each line of the picture and onto successive lines. This scanning action (the addressing of the model board, picture element by picture element) has provided a new and useful tool in solving the traditional problem of correlating target and background terrain images or matching two side-by-side pictures in adjacent windows. The image correlation system is implemented by detecting the position of the scanning laser beam on the model board at an instant of time and comparing it to the desired position. Error signals are then generated to correct the optical probe line-of-sight.

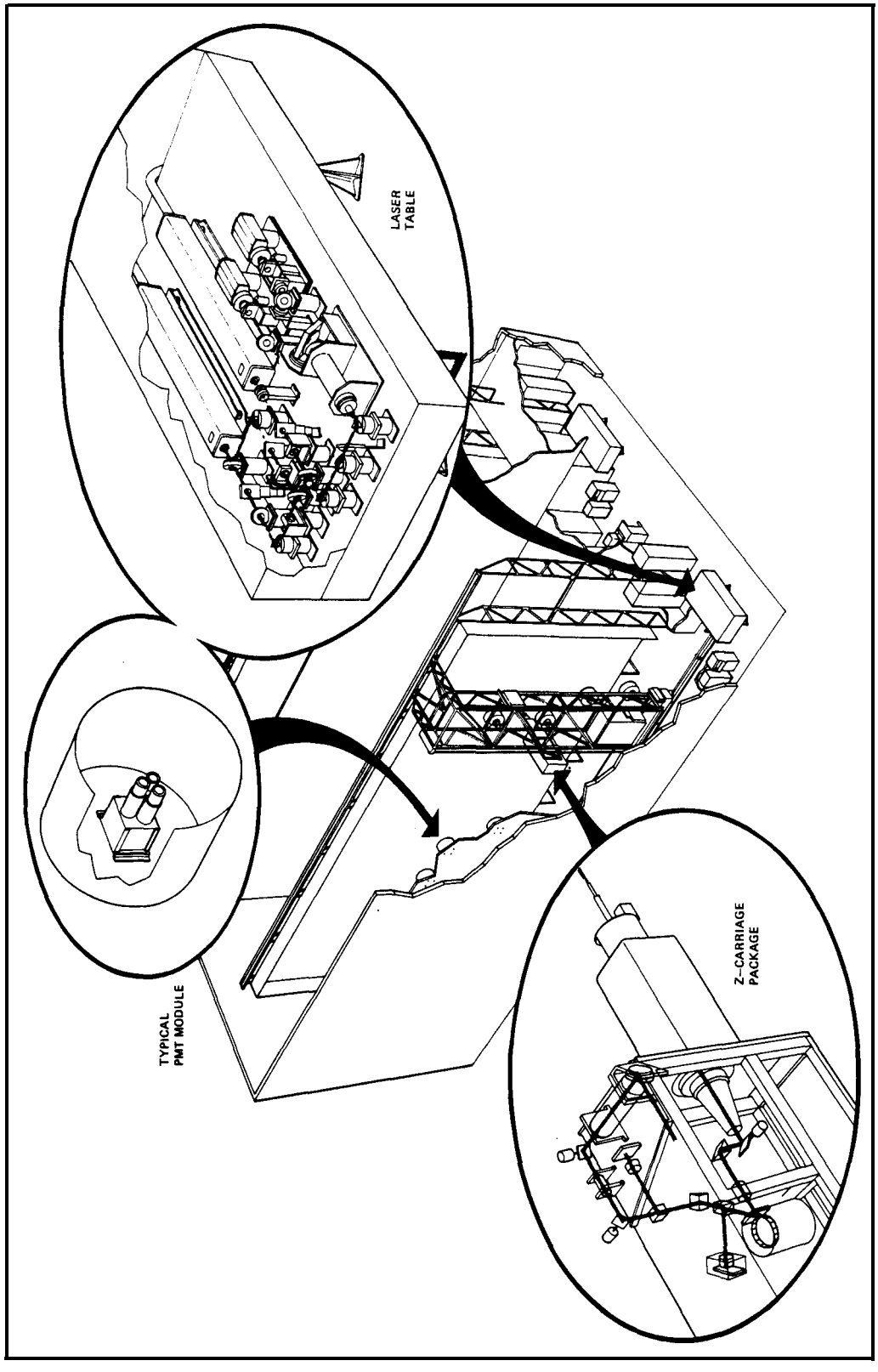


Figure 6-1. Laser Image Generator (LSIG) Visual System

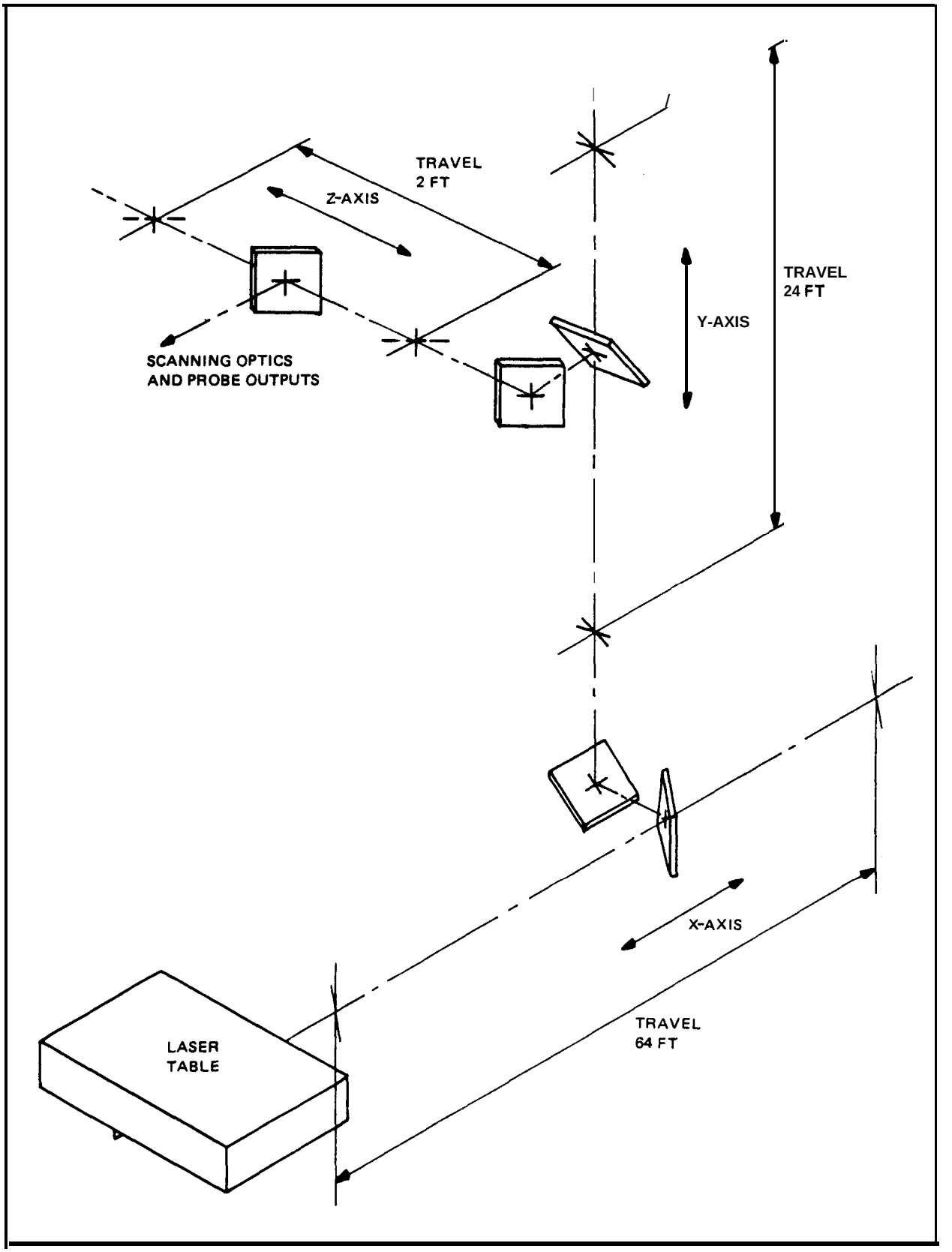


Figure **6-2. Laser Beam Transmission System Schematic Diagram**

6-9. LANDING ZONE LIGHTING. The landing zone lighting provided is listed in table 6-1. Under instructor/operator control, each of the five on/off control groups can be independently selected to be on or off as desired to enhance the training exercise. Associated with each light is an optical fiber that protrudes through the model board to a point just above the model surface. As the scanning laser beam is intercepted by the fiber tip, a photodetector at the other end of the fiber detects the light pulse and generates a corresponding video pulse of the appropriate color in the display video.

Table 6-1. Landing Zone Lighting

On/off control groups	Description	Color	Number of lights per group	Number of groups
1	Runway Edge	White	18	1
1	Taxi	White	8	1
2	Airfield Inverted Y	White	4	1
2	Pinnacle Inverted Y	White	4	1
3	Confined Landing Areas	White	4	8
4	Approach No. 1	White	63	1
4	Approach No. 2	White	63	1
4	Approach No. 3	Red	21	1
4	Approach No. 4	Green	18	1
5	Strobe	White	15	1

6-10. FIELD-OF-VIEW (FOV). The visual images generated by the LSIG are displayed to the pilot forward and side window displays and the gunner forward window display. The TSU image (CRISP, FLIR, or symbolic) is viewed through the mechanically fabricated TSU optics.

NOTE

Other than TSU target symbology versus model board targets, there is no correlation between the TSU display and the through-the-window displays.

a. Through-the-Window-Displays. The window visual displays are collimated; i.e., viewed at infinity. The total FOV visible by movement of the pilot or gunner's head is approximately 48 degrees horizontal and 36 degrees vertical for each display, with a 5.5-degree gap between the pilot forward and side window displays. All video system controls are preset, and the colors of the scene have been especially modeled to provide maximum contrast and enhance the training environment. The instructor/operator, therefore, has no requirement to adjust or control the color signal presented in the cockpit.

b. Telescopic Sight Unit (TSU). In the TSU, the CRISP and symbolic scenes have an apparent FOV consisting of a 36-degree circular image (in other words, when looking in the TSU, the student gunner's eye travels 36 degrees to scan the full image from side to side). The actual FOV (the angle of the scene image when viewed through the cockpit window) is 28 degrees in low magnification and 4.6 degrees in high magnification. For the TSU FLIR scene, a rectangular image is presented. The actual FOV in FLIR narrow FOV is 1.89 degrees by 2.52 degrees. The actual FOV in FLIR wide FOV is 4.52 degrees by 6.03 degrees.

6-11. WEAPONS EFFECTS. Weapons effects are generated by the weapon effects generator (WEG) to provide the crew with a visual scene that includes target signatures. The cockpit window displays portray such weapon effects as gun tracer trajectories, FFAR and TOW missile flightpaths, and tracer burnout or ground impact. The TSU imagery presents similar effects for the student gunner, which are generated by the CRISP system. These include weapons impact effects, tracers, missile launch effects (whiteout in CRISP night scene and FLIR scene). The weapons effects in each of the three types of Tsu scenes (cRISP, FLIR, or symbolic) are represented in different ways.

6-12. VISUAL SYSTEM CAPABILITIES. The following is a summary of the capabilities of the LSIG system:

a. Lighting. Video processing circuits adjust the video levels to provide either day, dusk, or night conditions of the visual scene.

b. Field-of-view. Each cockpit visual display provides a FOV of 48 degrees horizontal and 36 degrees vertical, centered on the horizon with the proper perspective.

c. Landing Areas. The model board provides landing areas as defined on CRT pages 030 through 040.

d. Special Effects. The special effects generator produces signals that, when displayed, create the impressions of clouds, fog, blue sky, and above-cloud simulation, and transition between them. An artificial horizon circuit provides for a smooth transition from model board terrain video to a cloud haze band and then to blue sky above clouds. The visual effects of ceiling, overcast, and visibility ranging can be selected at the IOS console. This allows transition between IFR and VFR .

e. Weapons Effects. The WEG provides the crew with visual projectile signatures and target signatures.

f. Altitude Representation. The eyepoint altitude simulated by the visual system is continuously tracked from 6.25 to 2000 feet above the runway level, which corresponds in scale to the limit of the Z-carriage excursion. No visual model board terrain is presented above altitudes of 2000 feet: the visual scene changes to flight through clouds and then flight above clouds.

g. Focus. Optical probe focus is dynamically controlled by the software to maintain optimum focus at all altitudes. Under instructor control, the automatic tilt and focus controls can be disabled to provide a special focus condition optimized for low-level confined landing area operation. Instructor selection of this focus mode at low altitude levels can cause a noticeable out-of-focus condition during the 2- to 3-second transition period. Selection at higher altitudes will result in a less noticeable out-of-focus condition during the transition period.

h. Ambient Light Effect. The daylight ambient light level of the cockpit is less than that encountered during normal daytime VFR flight. It is therefore necessary to keep IOS control panel and FWS compartment overhead lighting set at IFR nighttime levels.

i. Probe Protection. A probe-height sensor system is provided to protect the probe from contacting the model board. If such contact should occur, which is highly unlikely, optical misalignment and possibly costly damage could occur. Aircraft airspeed for low-level and nap-of-the-earth flights should be limited to a maximum of 90 knots to remain within safe operating limits for low-level flight probe protection. Above 90 knots, the performance of the dynamic software protection is marginal. Invalid crashes may occur, or an impending crash may not be detected.

j. Visual Transition. When the simulated aircraft leaves the model board perimeter areas, no visual terrain reference exists, and simulated flight through clouds occurs.

k. Night Vision Goggles. The simulator cockpit has been modified for use with the AN/AVS-6 aviator's night vision imagery system (ANVIS), and AN/PVS-5 night vision goggles (NVG) so that the instruments and controls are visible when the pilot/copilot wears NVG or ANVIS. Blue-green lighting compatible with the night vision goggles is provided by floodlights and utility lights. Compatible postlights provide supplemental instrument lighting.

CHAPTER 7

NORMAL OPERATING PROCEDURES

Section I. INITIATION OF TRAINING

7-1. INITIAL PROCEDURES. A training program can take various paths, depending upon the level of crew expertise, or the need to present a broadly defined or a speciality program of instruction. Certain minimum procedural steps usually take place for initiating training:

a. System turnon and readiness checks are performed by maintenance personnel following the procedure given in Chapter 2, Section I, of TD-55-6930-213-23-1. These are completed prior to the first scheduled training period of the day.

b. Prior to entering cockpit, crew should ensure that all safety/gate interlocks are established to enable motion system operation. Upon entry into the cockpit by the pilot and/or gunner, aircraft controls, switch positions, and circuit breakers should be checked, following the prescribed aircraft operational checklist.

c. For all training, these procedures apply to both instructor/operators in the independent mode and to the pilot instructor/operator in the integrated mode. The cockpits are initially in the independent mode at the completion of turnon and readiness checks. If it is desired to operate in the integrated mode, it must be selected while both cockpits are in freeze. Switching between modes requires notification of visual maintenance personnel. Up to a 20-minute waiting period may be required for reconfiguration of the probe height sensors. Determination of either independent or integrated mode should be made before the start of a training mission.

d. Training can now proceed by securing doors, fastening all seat belts, initisting motion, and unfreezing the simulator. When the system has been turned on (cold start) and the computer first loaded, the flight weapons simulator (FWS) is initialized at IC set 002 (CRT page 02) and is in a freeze condition. (See figure 7-1, sheet 1, for a description of the initial conditions (IC) values on CRT page 02.) For alternate IC choices, the system INDEX page can be accessed by simply depressing the ENTER keyswitch on the IOS CRT console. However, at times, due to display memory assignment locations, it may also be necessary to depress the INTERCHANGE DISPL keyswitch to view the INDEX. Once displayed, the instructor/operator can obtain additional information, parameter selections, and simplified programming instructions by depressing the DISPL ADV or the DISPL REV switchlights. These sequentially step through the index related CRT pages (shown in figures 7-2 through 7-7). Other preprogrammed initial conditions (IC) sets can be called up or a complete IC set can be initiated and modified by the instructor/operator on CRT page 11. (See figure 7-1, sheet 2.) Preprogrammed checkrides or demonstrations can be called up as part of the training program. Weapon loading configuration, target selection and visual scene effects can be initiated or modified as desired. Information on the use and setup of these conditions is provided further in this chapter.

7-2. ZEROING (DATA CLEAR). Actuating DATA CLEAR at any time deletes all accumulated ground track and previously entered malfunctions, clears the out-of-tolerance error table, unfreezes all parameters, and resets the mission elapsed time (MET) indication on the CRT. The MASTER MALF CLR/INH deletes any existing malfunctions previously inserted.

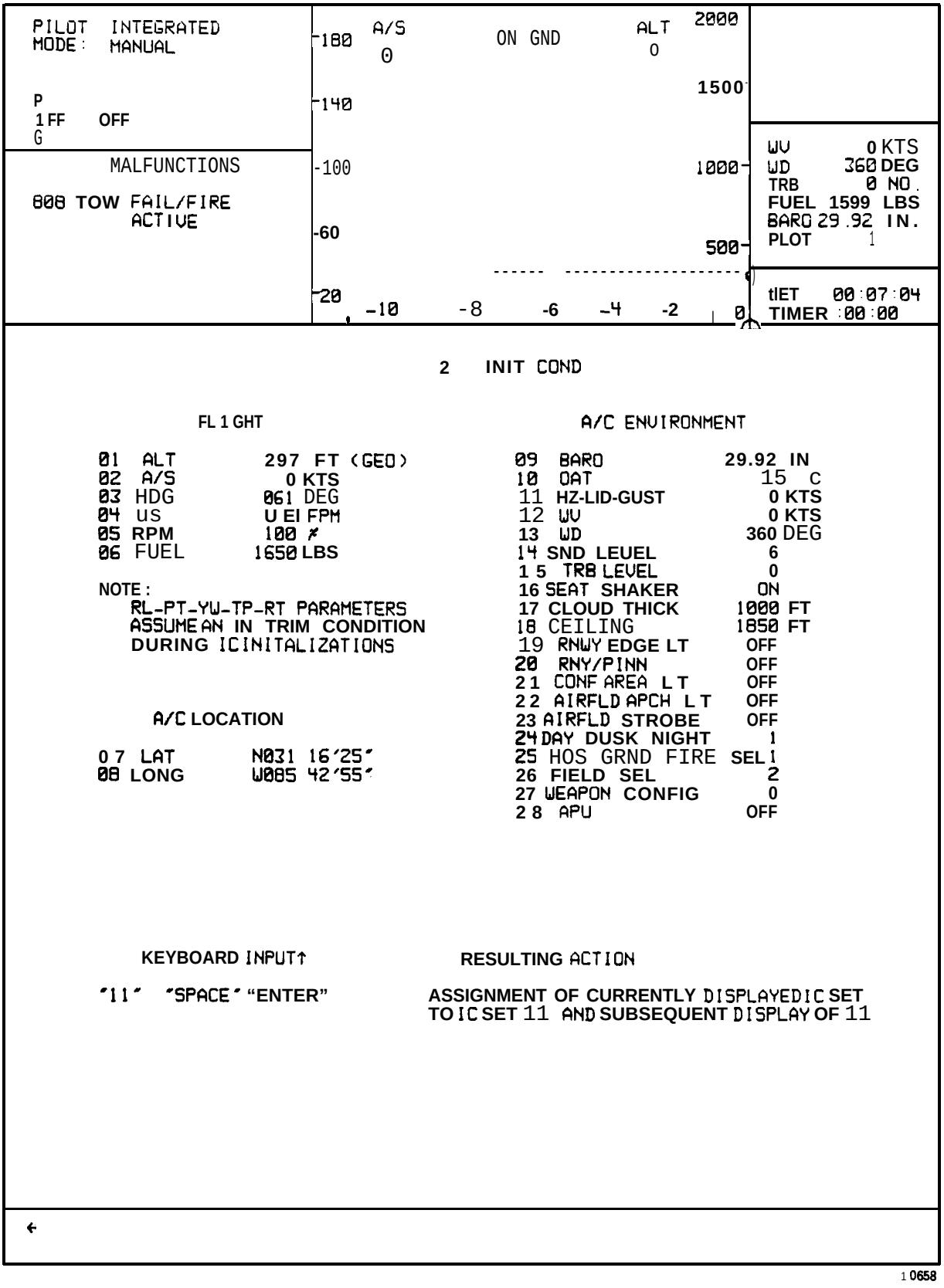


Figure 7-1. Initial Conditions (Sheet 1)

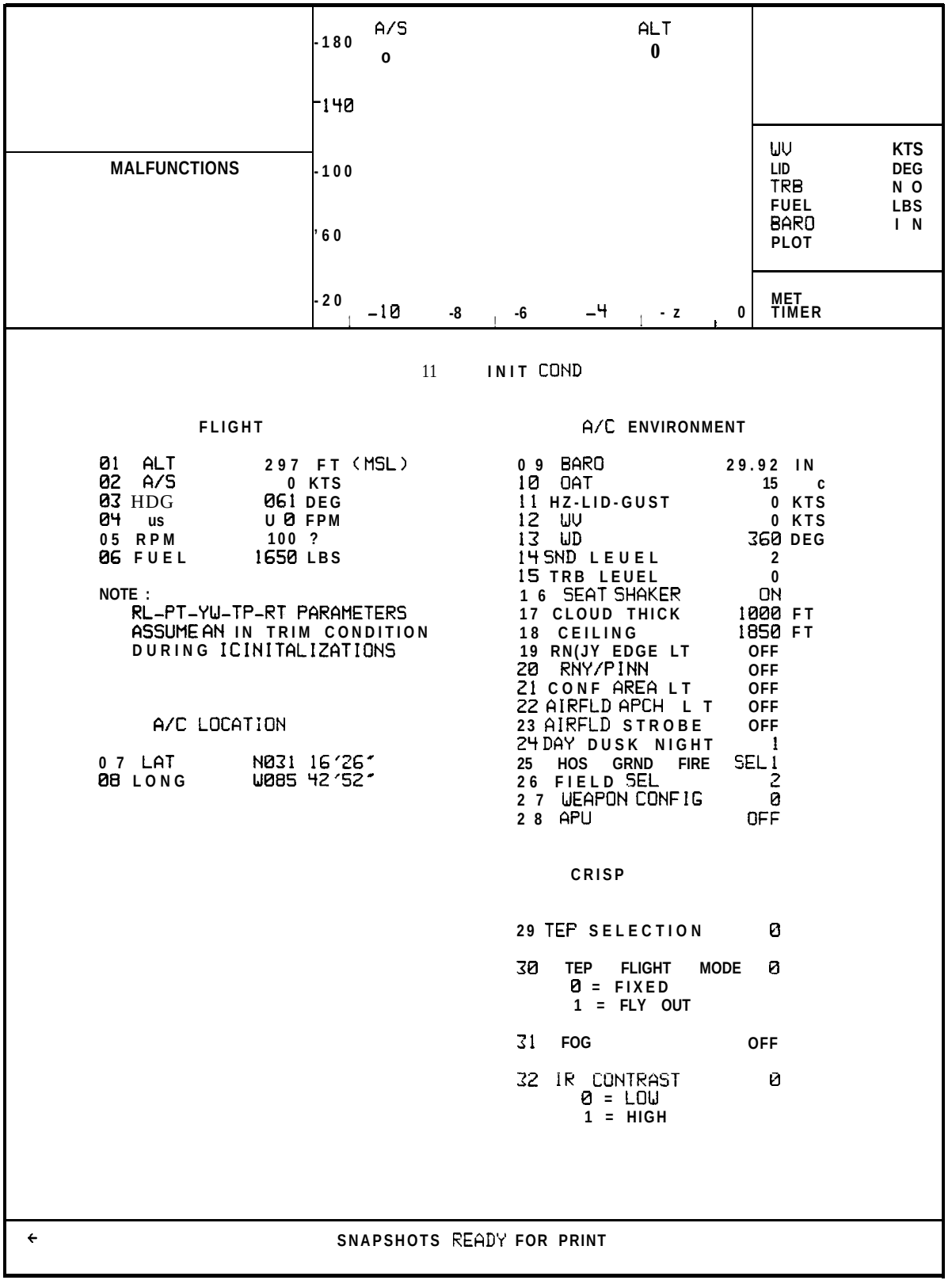


Figure 7-1. Initial Conditions (Sheet 2)

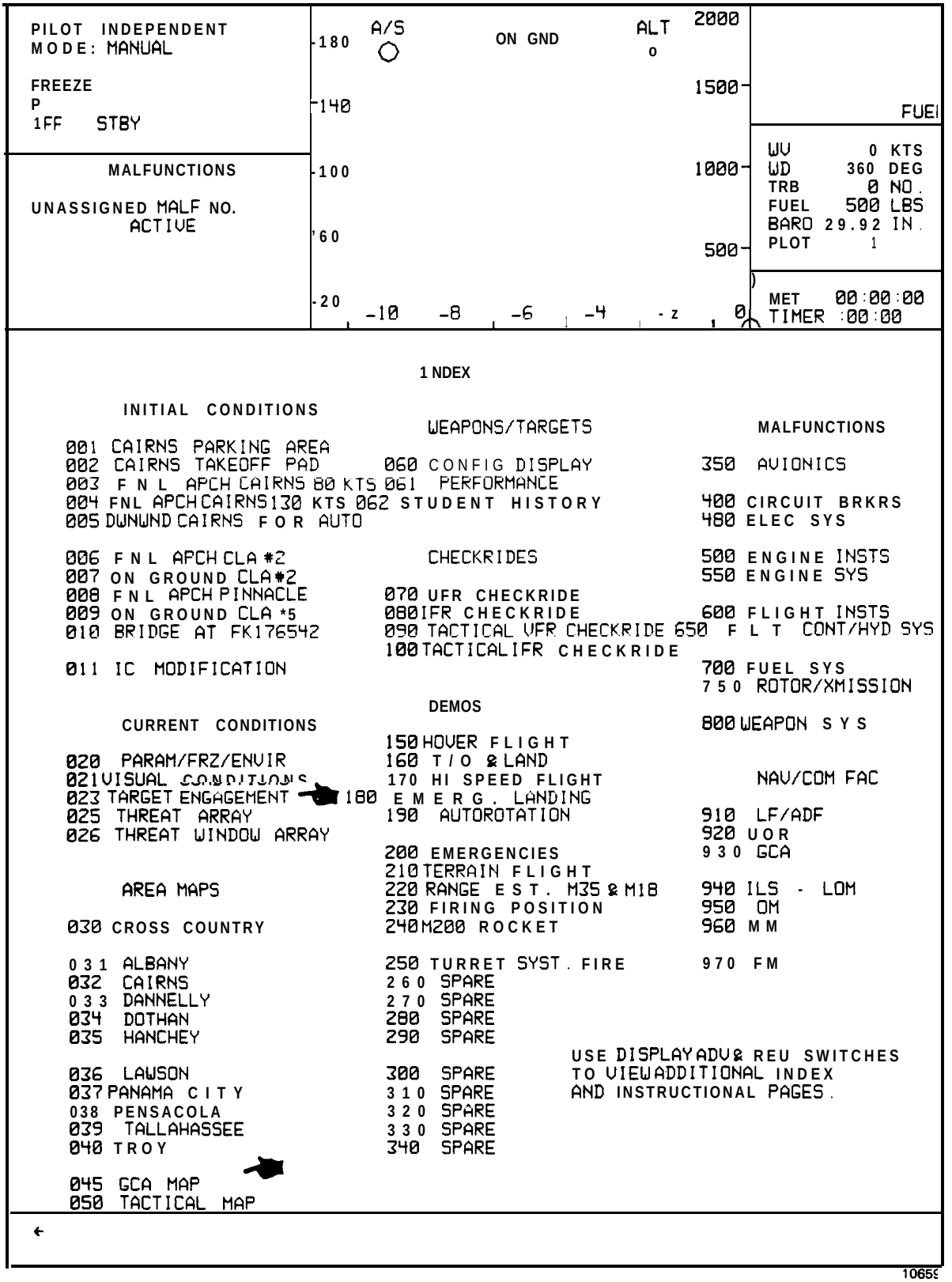


Figure 7–2. Typical Index Page

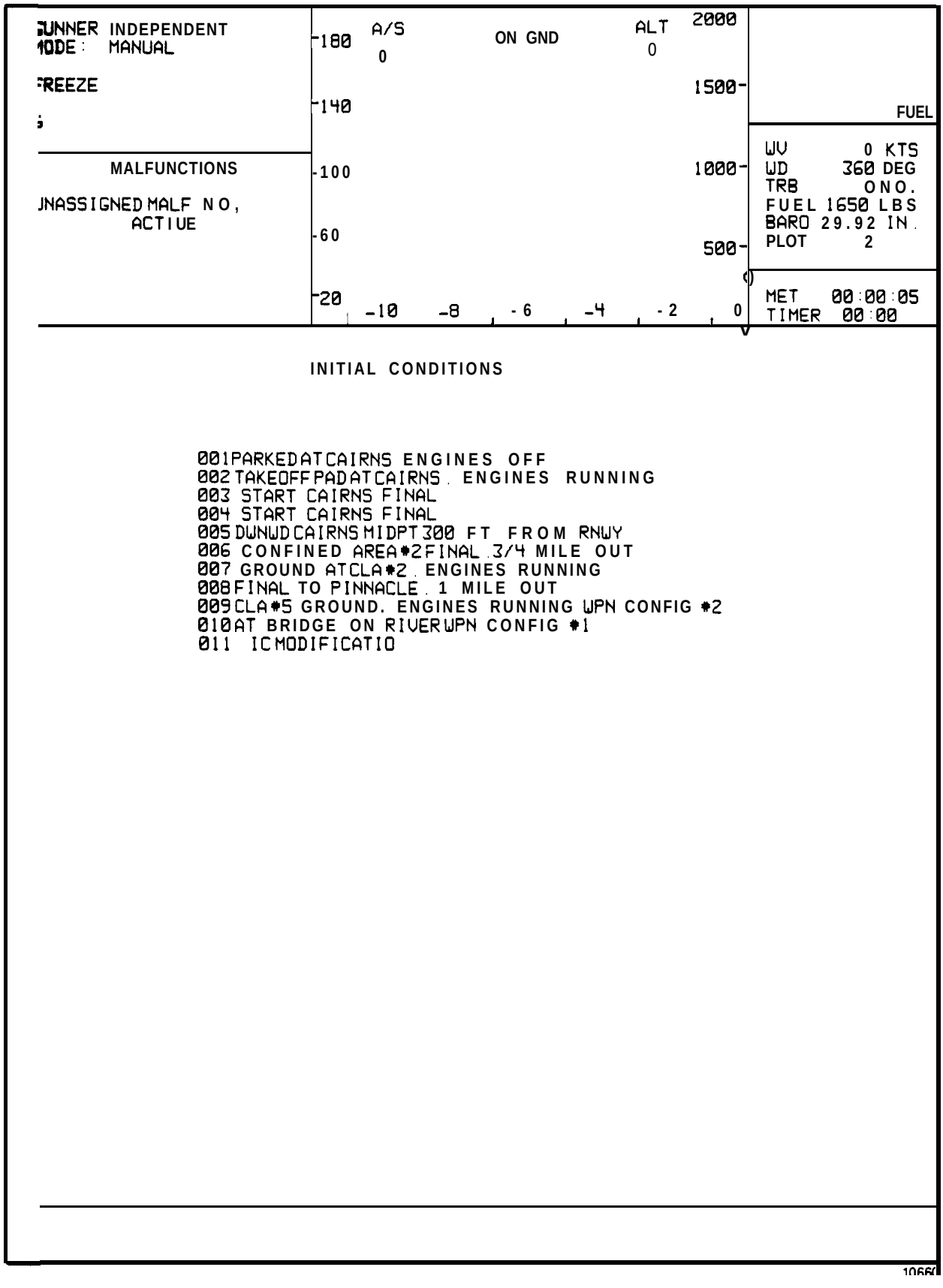
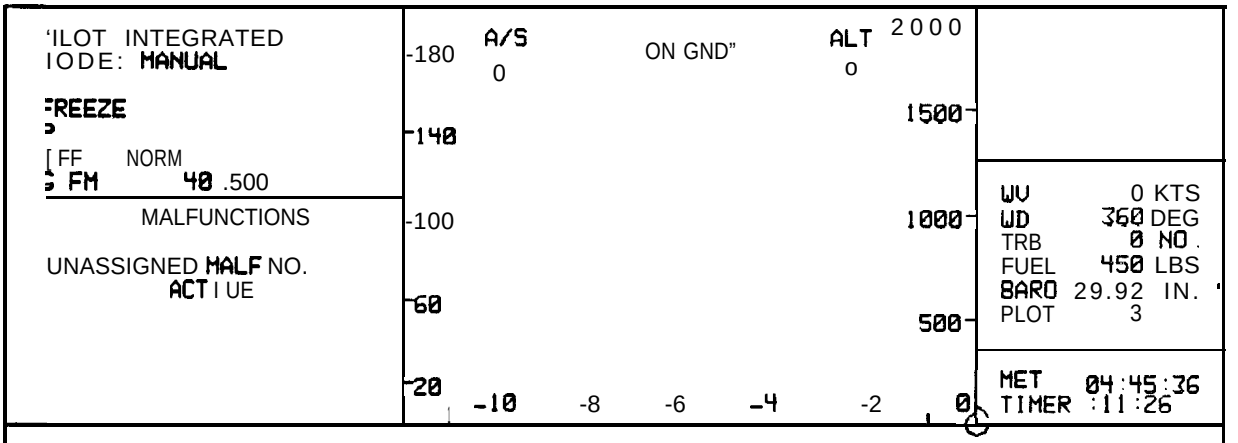


Figure 7-3. Typical IC Listing



INSTRUCTION PAGE 1

[. EDITING PARAMETERS

NUMBERED LINES INDICATE EDITABLE PARAMETERS ON INTERACTIVE PAGES. KEYBOARD INPUT FOR EDITING IS AS FOLLOWS:

A. ARITHMETIC PARAMETERS

'LINE NO." "SPACE" "VALUE DESIRED "ENTER"

1. FOR PARAMETERS HAVING U/D OR R/L QUALIFIERS A MINUS VALUE IMPLIES D OR L.

2. IF VALUE IS NOT WITHIN EDITABLE LIMITS FOR THE LINE AN ERROR MESSAGE IJILL BE GENERATED.

B. BOOLEAN PARAMETERS - SET/CLR ON/OFF

"LINE NO." "SPACE" "1" "ENTER" - GIVES PARAMETER 'SET" OR "ON" STATE

"LINE NO." "SPACE" ["0"] "ENTER" - GIVES PARAMETER "CLR" OR 'OFF STATE

I. FREEZING PARAMETERS CLINES 1-11 ON PAGE 20]

'LINE NO." "SPACE" "*" 'ENTER" - FREEZES CORRESPONDING PARAMETER

'LINE NO." "SPACE" 'ENTER - UNFREEZES CORRESPONDING PARAMETER

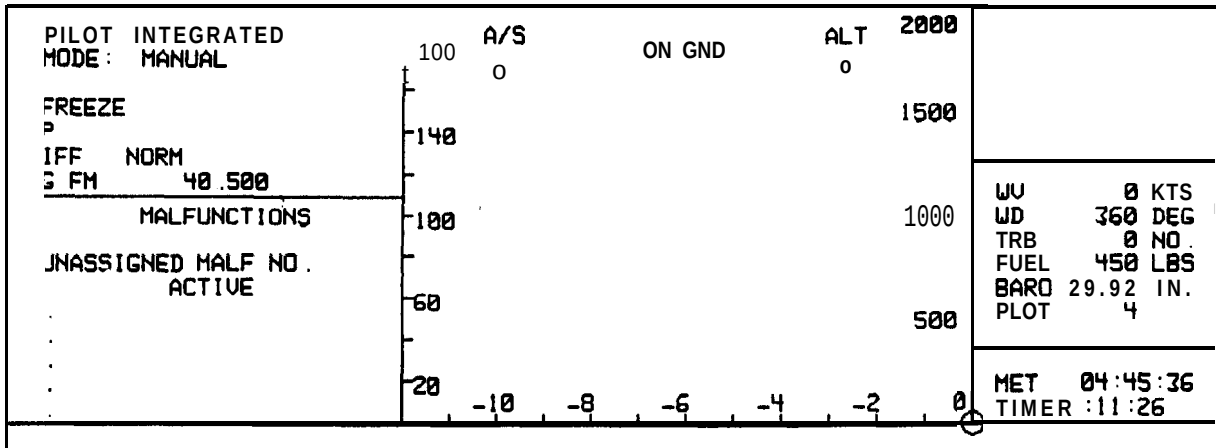
11. FAILING RADIO FACILITIES

INDIVIDUAL FACILITIES LISTED ON NAV AIDS INDEX PAGES ARE FAILABLE

"LINE NO." "SPACE" "*" "ENTER' - FAILS CORRESPONDING FACILITY

"LINE NO." 'SPACE" "ENTER" - ENABLES CORRESPONDING FACILITY

Figure 7-4. CRT Instruction Page 1



INSTRUCTION PAGE 2

IV. INITIAL COND TIONS

1. TRAINER MUST BE IN FREEZE BEFORE ANIC SET CAN BE INSERTED.

2. IC SETS ARE NSERTED BY DIALING THE SET NUMBER (1-11) ON THE THUMBWHEEL AND PUSHING THE INSERT SWITCH.

3. ONLY IC SET 11 IS EDITABLE. VALUES OF ANOTHER DISPLAYEDIC SET MAY BE TRANSFERRED TO SET 11 FOR EDITING (SEE INSTRUCTIONS ON IC PAGES). IC SET 11 WILL RETAIN ITS EDITED VALUES FOR THE DURATION OF THE DAY OR UNTIL NEW VALUES ARE ENTERED BY THE INSTRUCTOR.

4. ADDITIONAL IC SETS BEYOND SET 11 ARE REACHED VIA THE" DISPLAY ADVANCE AND REVERSE SWITCHES. TO INSERT ONE OF THESE SETS IT MUST FIRST BE TRANSFERRED TO SET 11. SET 11 CAN THEN BE INSERTED VIA THE THUMBWHEEL.

J. OFFLINE MODE

1. BOTH COCKPITS MUST BE IN FREEZE TO GO OFFLINE. IF THEY ARE NOT THE OFFLINE SWITCHES ARE BLINKED.

2. ONCE IN FREEZE TRAINER MAY BE PUT IN OFFLINE MODE FROH EITHER COCKPIT VIA OFFLINE SWITCH.

3. OFFLINE MODE IS NOT REQUIRED TO PROCESS HARDCOPYS. ALL HARDCOPY PROCESSING IS CURRENTLY DONE ONLINE. THE OFFLINE MODE IS PROVIDED FOR FUTURE USE.

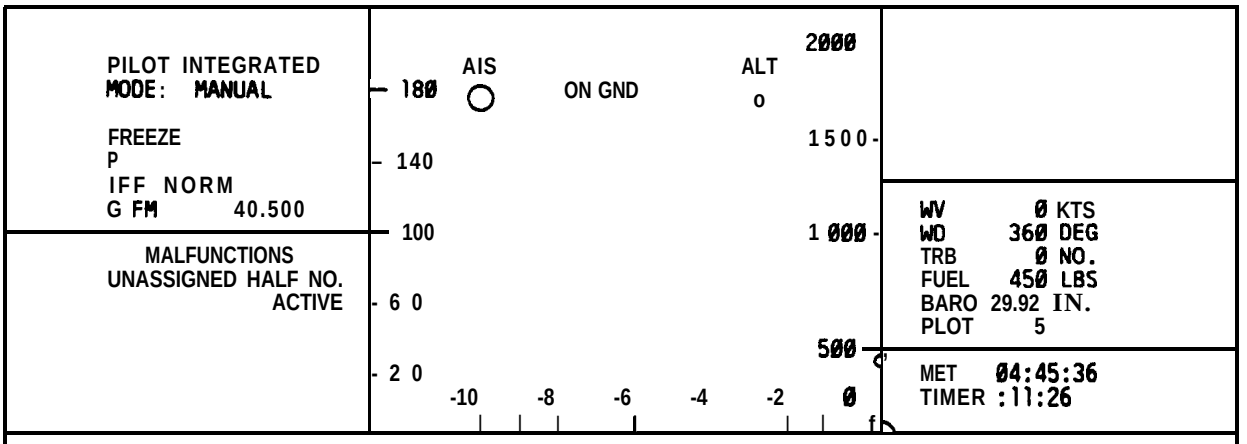
4. OFFLINE MODE CAN BE DELETED BY THE COCKPIT THAT REQUESTED IT. VIA THE OFFLINE SWITCH.

)1. INTEGRATED MODE

1. BOTH COCKPITS MUST BE IN FREEZE BEFORE ENTERING OR LEAVING INTEGRATED MODE IF NOT IN FREEZE INTEGRATED MODE SWITCH IS BLINKED.

2. ONCE IN FREEZE THE PILOT COCKPIT CAN TAKE TRAINER IN OR OUT OF INTEGRATED MODE VIA INTEGRATED MODE SWITCH.

Figure 7-5. CRT Instruction Page 2



INSTRUCTION PAGE 3

VII DEMONSTRATION RECORD

1. THE SIMULATOR MUST BE IN INTEGRATE MANUAL MODE ANO IN FREEZE.

2. DEPRESS THE DEMO RECORD SWITCH. IT WILL ILLUMINATE.

3. DIAL THE NUMBER OF THE DEMONSTRATION YOU WISH TO RECORD ON THE THUMBWHEEL AND DEPRESS THE INSERT SWITCH. IF A DEMONSTRATION ALREAOY EXISTS YOU WILL RECEIVE A MESSAGE TELLING YOU SO. IF YOU WISH TO RECORD OVER IT THEN YOU MUST OEPRESS THE INSERT SWITCH AGAIN.

4. EDIT AUDIO RECORD MODE ALLOWS FOR THE AUDIO TO BE RECORDED WHILE THE DEMONSTRATION IS PLAYING BACK.

5. A MANEUVER ARK IS A POINT AT WHICH YOU MAY BEGIN PLAYING BACK A DEMONSTRATION. IT IS ALSO A POINT FROM WHICH YOU MAY RERECORD A DEMONSTRATION. A MANEUVER MARK MAY BE INSERTED AT ANY POINT DURING THE RECORDING OF THE DEMONSTRATION. THE MAXIMUM NUMBER OF MANEUVER MARKS PER DEMONSTRATION IS 9.

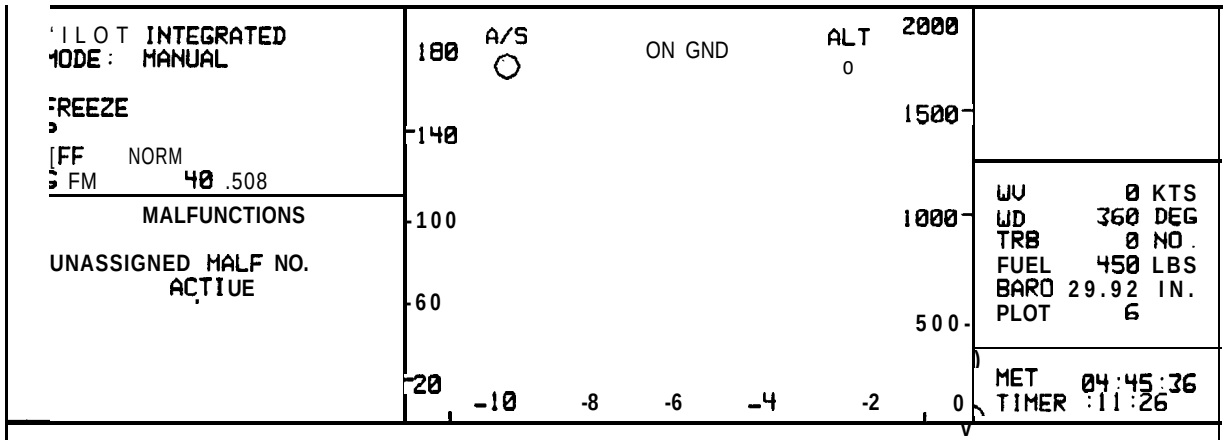
6. FRZ ON MANUV MARK MAY BE USED IN THE DEMO RECORD MODE OR THE EDIT AUDIO RECORD MODE. IF THIS SWITCH IS ILLUMINATED IN THE DEMO RECORD MODE AND A MANEUVER MARK IS INSERTED THE SIMULATOR WILL FREEZE. IF THIS SWITCH IS ILLUMINATED IN THE EDIT AUDIO RECORD MODE ANOA MANEUVER MARK IS ENCOUNTERED THE SIMULATOR WILL FREEZE.

7. EDIT MARK/PAUSE MAY BE USED IN EITHER DEMO RECORD MODE OR EDIT AUDIO RECORD MODE. WHEN USED IN THE DEMO RECORD MODE IT WILL PLACE A HARK THAT MILL CAUSE THE SIMULATOR TO FREEZE IN THE EOIT AUDIO RECORD MODE. WHEN IT IS USED IN THE EDIT AUDIO RECORD MODE ITWILL PLACE A PERMANENT PAUSE IN THE RECORDING. THE PAUSE WILL BE AS LONG AS THE EOIT MARK/PAUSE LIGHT IS ON.

8. EDIT SLOW TIME CAN ONLY BE USEO IN THE EDIT AUDIO RECORD MODE. WHEN THIS SWITCH IS ILLUMINATE SLOW TIME WILL BE RECORDED INTO THE DEMONSTRATION. SLOW TIME IS HALF AS FAST AS THE NORMAL SPEED.

9. DEMO RECORD MODE MAY BE EXITED ONE OF TWO WAYS 1) DEPRESSING THE OELETE SWITCH WITH THE CORRESPONDING DEMONSTRATION NUMBER ON THE THUMBWHEEL 2) DEPRESSING THE DEMO RECORD SWITCH EXTINGUISHING THE LIGHT.

Figure 7-6. CRT Instruction Page 3



INSTRUCTION PAGE 4

)III DEMONSTRATION PLAYBACK

1. THE SIMULATOR MUST BE IN MANUAL MODE AND IN FREEZE, IT MAY BE IN INDEPENDENT OR INTEGRATED MODE.

2. DIAL THE NUMBER OF THE DEMONSTATION OF INTREST ON THE THUMBWHEEL. DEPRESS THE INSERT SWITCH.

3. WHEN THE FREEZE LIGHT STOPS BLINKING DEPRESS IT AND THE DEMONSTRATION WILL BEGIN.

4. A DEMONSTRATION MAY BE STARTED FROM A MANEUVER MARK. ADD THE MANEUVER MARK OF INTREST (1-9) TO THE DEMONSTRATION NUMBER. THE REST OF THE PROCEDURE IS THE SAME AS A DEMONSTRATION PLAYBACK..

X CHECKRIDE/EXERCISE MODE

1. THE SIMULATOR MUST BE IN MANUAL MODE AND IN FREEZE.

Z. A CHECKRIDE OR EXERCISE MAY BE SELECTED ONLY BY THE PILOT COCKPIT IN EITHER THE INDEPENDENT OR INTEGRATED MODE.

3. DIAL THE CHECKRIDE NUMBER OF INTEREST ON THE THUMBWHEEL. DEPRESS THE INSERT SWITCH. WHEN THE FREEZE LIGHT STOPS BLINKING DEPRESS IT.

4. THE INSTRUCTOR IS ONLY ALLOWED TO LOOK AT PAGES AND MAPS.

5. AN EXERCISE IS A SUBSET OF A CHECKRIDE. TO SELECT AN EXERCISE ADD THE EXERCISE NUMBER (1-9) OF INTEREST TO THE CHECKRIDE NUMBER. THEN DIAL THIS NUMBER ON THE THUMBWHEEL AND DEPRESS INSERT. THE REST OF THE PROCEDURE IS THE SAME AS CHECKRIDE.

Figure 7-7. CRT Instruction Page 4

7-3. INITIALIZATION OF NORMAL TRAINING. Initialization requires use of and is performed at the IOS consoles. The cockpit control panel switches are in parallel with the IOS controls and are available for a problem or emergency use. The FREEZE, EMER STOP, and MOTION ON, MOTION OFF switchlights at the IOS and cockpit control panels have identical capabilities. (Functions of these controls are discussed in Section III of this chapter.)

WARNING

Alert pilot and gunner to clear all controls prior to initialization. Abrupt movement of controls by the computer may cause injury.

a. Initialize to a Preprogrammed IC Set. The desired IC number (01 through 10) should be dialed into the three-digit thumbwheel selector and the INSERT switchlight depressed. During initialization, the FREEZE indicators blink and the visual system reverts to a ready-wait condition. When initialization is complete, the flight controls will have been correctly positioned by the computer, the freeze switchlights will revert to steady on and the visual system will revert to READY. The FWS is now ready for training mode operation. Before continuing, the operator may want to select an appropriate CRT display page for problem monitoring.

b. Initialize to an IC Set Not Preprogrammed. An existing IC is assigned to IC set 11 and then edited. This operation is performed at the CRT console keyboard. First, type the desired IC page 01 through 10, which is to be edited, then type ENTER . The selected IC set appears on the CRT display. Assign this set to set 11 by typing 11, space, ENTER. Now any or all values of the displayed set can be changed on a line-by-line basis by using the keyboard. When a value outside the limits of the accepted range is entered for any line, the computer refuses to accept the value upon entry, and an error message is displayed in the l-inch scratchpad display area below the IC set display. Once editing is complete, the modified IC set can be initialized by dialing 011 on the 3-digit thumbwheel and depressing INSERT.

c. Initialize to a Preprogrammed Checkride IC Set. Training can be initialized from a group of four IC sets preprogrammed for checkrides (70, 80, 90 and 100). As shown in the CRT display pages (figures 7-8 through 7-11), these four major checkride programs can be subdivided to checkride exercises. The exercises within a program can be individually selected or arranged in any order to form a program.

d. Weapon Loading. Ten different weapon configurations are available on CRT page 60. (See figure 7-12.) This display is presented on the CRT by typing 60, ENTER on the CRT console keyboard. Determine and select the appropriate weapon configuration number, which is then loaded onboard the aircraft using either of the following procedures:

(1) Call up current conditions parameter/freeze/environment set page 20 by typing 20, ENTER on the CRT. Type line 25, space, configuration number previously derived from page 60 (1 through 10), ENTER on keyboard.

(2) Call up performance display page 61. (See figure 7-13.) Type line number 7, space, configuration number derived from page 60 (1 through 10), ENTER.

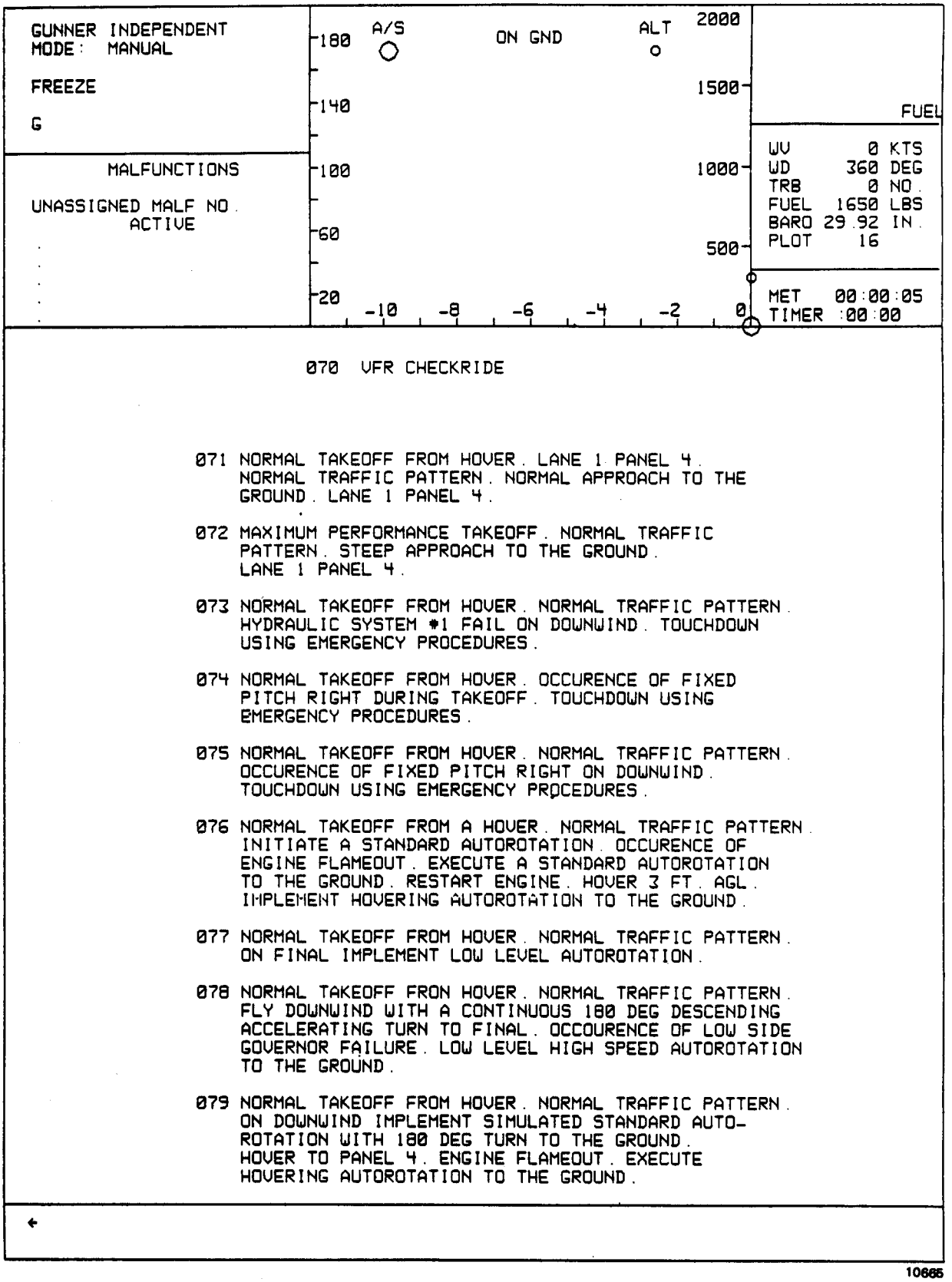


Figure 7-8. VFR Checkride Program Page 070

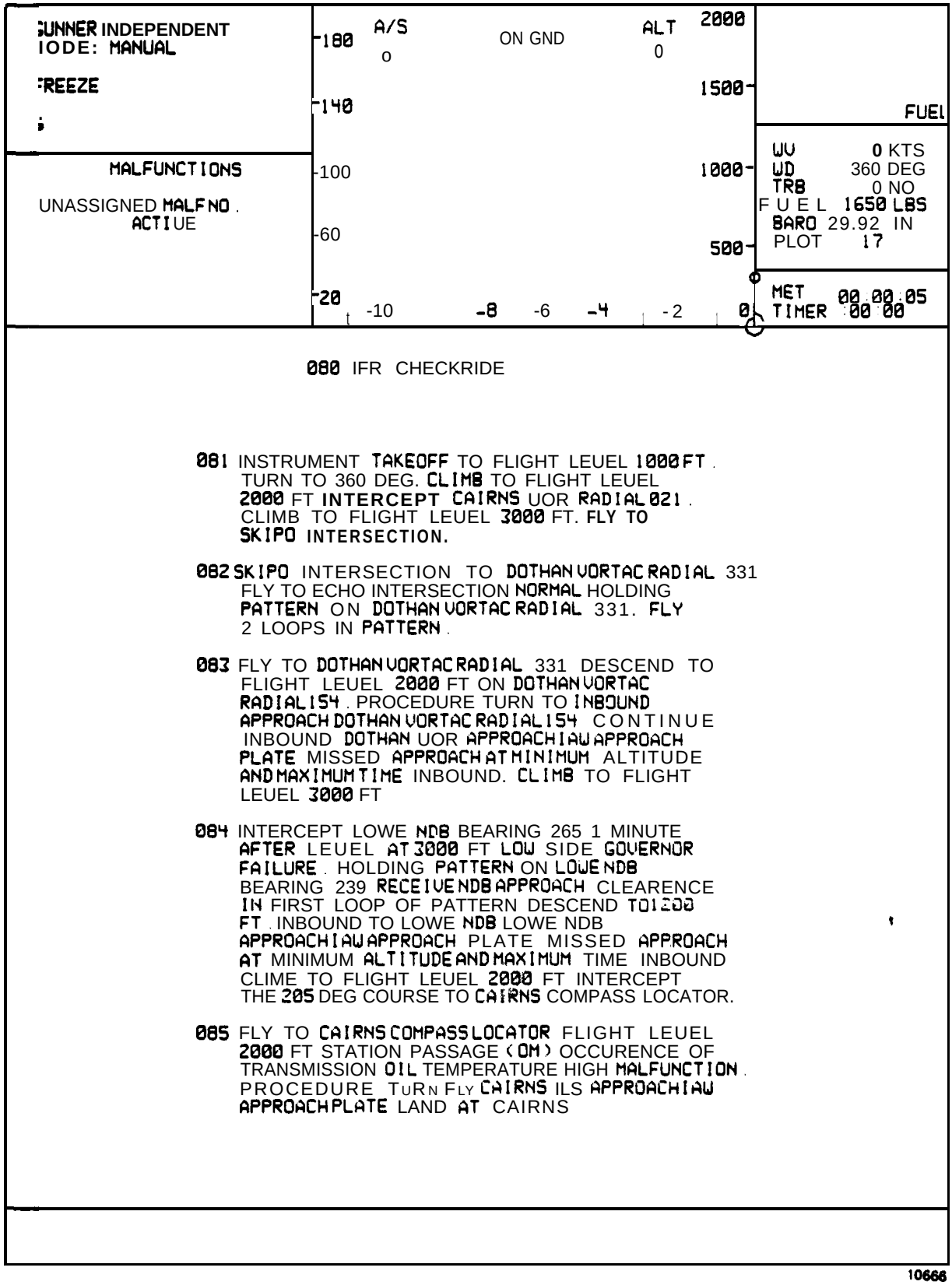
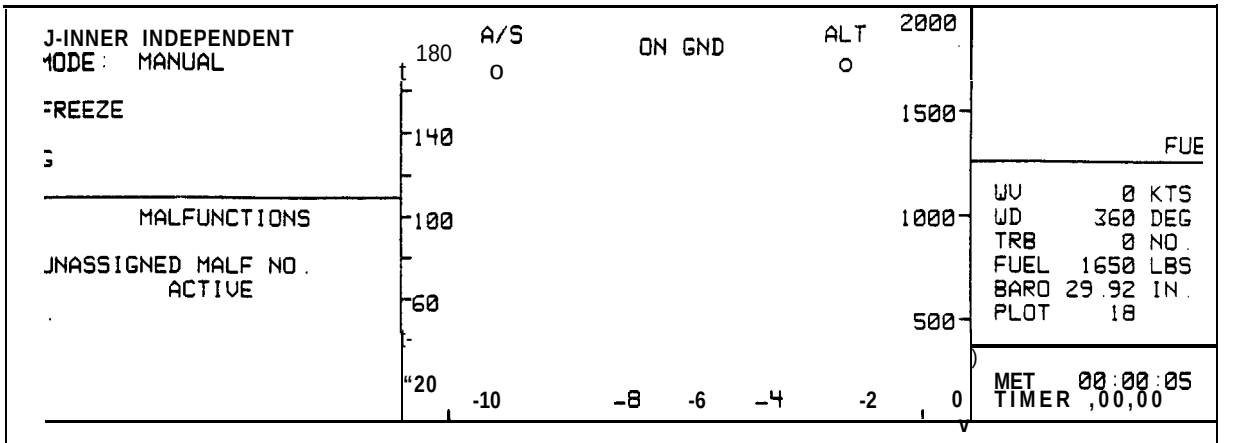


Figure 7-9. IFR Checkride Program Page 080



090 TACTICAL WEAPONS CHECKRIDE

091 NORMAL TAKEOFF FROM CAIRNS CONTOUR FLIGHT TO CHECKPOINT BRIDGE.

092 NAP OF THE EARTH FLIGHT TO ATTACK POSITON NUMBER 1 ATTACK BMP WITH 20MM. BREAK OFF ATTACK.

093 NAP OF THE EARTH FLIGHT TO ATTACK POSITION NUMBER 2. ATTACK TANK WITH TOW MISSILE. HUNG MISSILE, SELECT SECOND MISSLE AND FIRE. BREAK OFF ATTACK.

094 NAP OF THE EARTH FLIGHT TO ATTACK POSITION NUMBER 3. ATTACK BMP WITH 2,75" ROCKETS. HUNG ROCKET, COMPLETE ROCKET ATTACK. BREAK OFF ATTACK.

095 CONTOUR FLIGHT TO CAIRNS. HYDRAULIC SYSTEM NUMBER 2 FAILURE. LAND AT CAIRNS USING EMERGENCY LANDING PROCEDURES

10667

Figure 7-10. Tactical Weapons **Checkride** Program Page 090

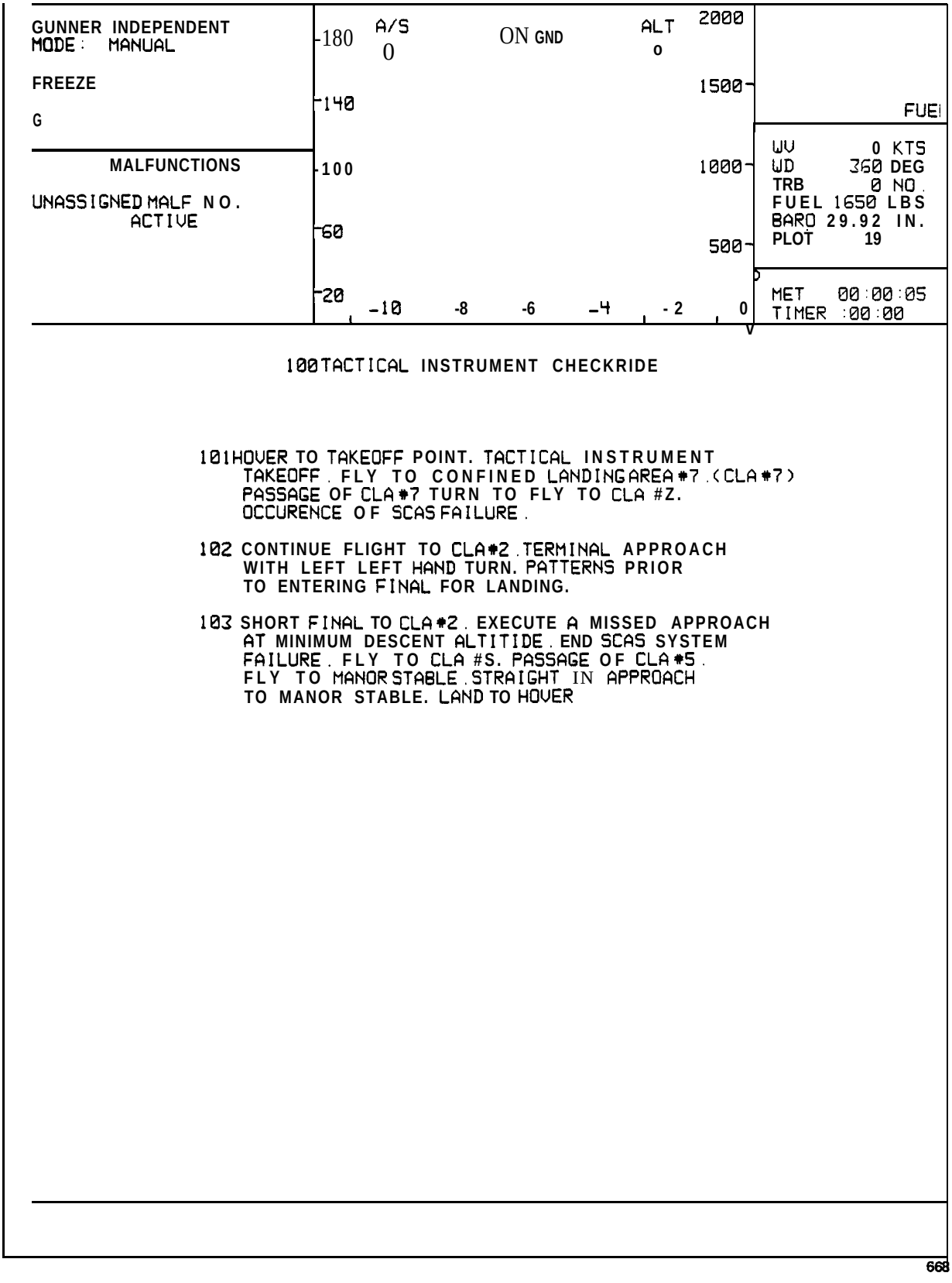
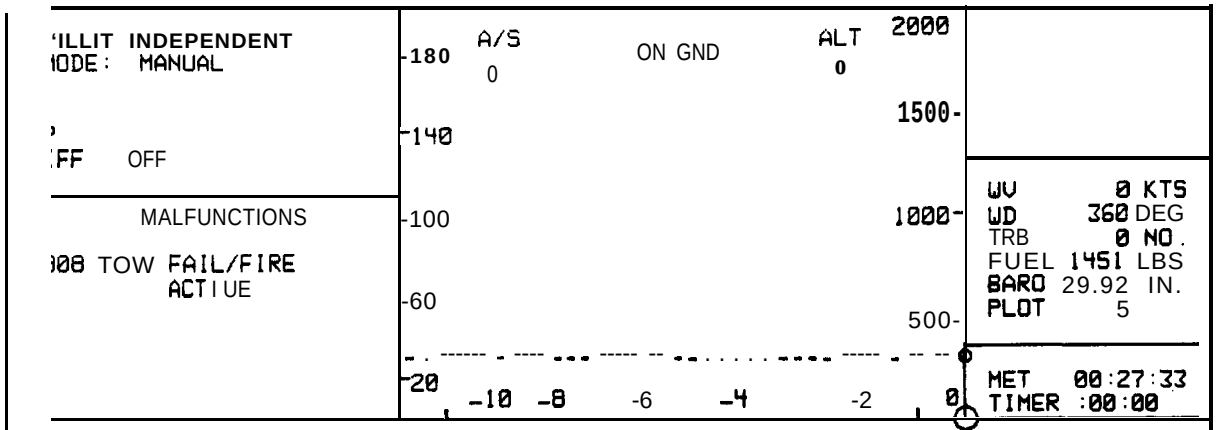


Figure 7-11. Tactical Instrument Checkride Program Page 100



060 CONFIGURATION DISPLAY

	LO	LI	TURRET	RI	RO	FUEL
1	TOW / 2	2.75 / 19	20 / 750	2.75 / 19	TOW / 2	800
2	TOW / 4	0 / 0	20 / 750	0 / 0	TOW / 4	1540
3	TOW / 4	z .75 / 19	20 / 750	2 .?5 / 19	TOW / 4	464
4	TOW / 4	2.75 / 7	20 / 750	2.75 / 7	TOW / 4	1162
5	z .75 / 19	2.75 / 19	20 / 750	2.75 / 19	2 .75 / 19	60
6	TOW / 2	z .75 / 19	30 / 500	2.75 / 19	TOW / 2	808
7	TOW / 4	0 / 0	30 / 500	0 / 0	TOW / 4	1548
8	TOW / 4	2.75 / 19	30 / 500	2 .75 / 19	TOW / 4	472
9	TOW / 4	2 .75 / 7	30 / 500	2.75 / 7	TOW / 4	1170
10	2 .7 5 / 19	2.75 / 19	30 / 500	2.75 / 19	2 .75 / 19	68

SNAPSHOTS READY FOR PRINT

10669

Figure 7-12. Weapons Configuration Page 060

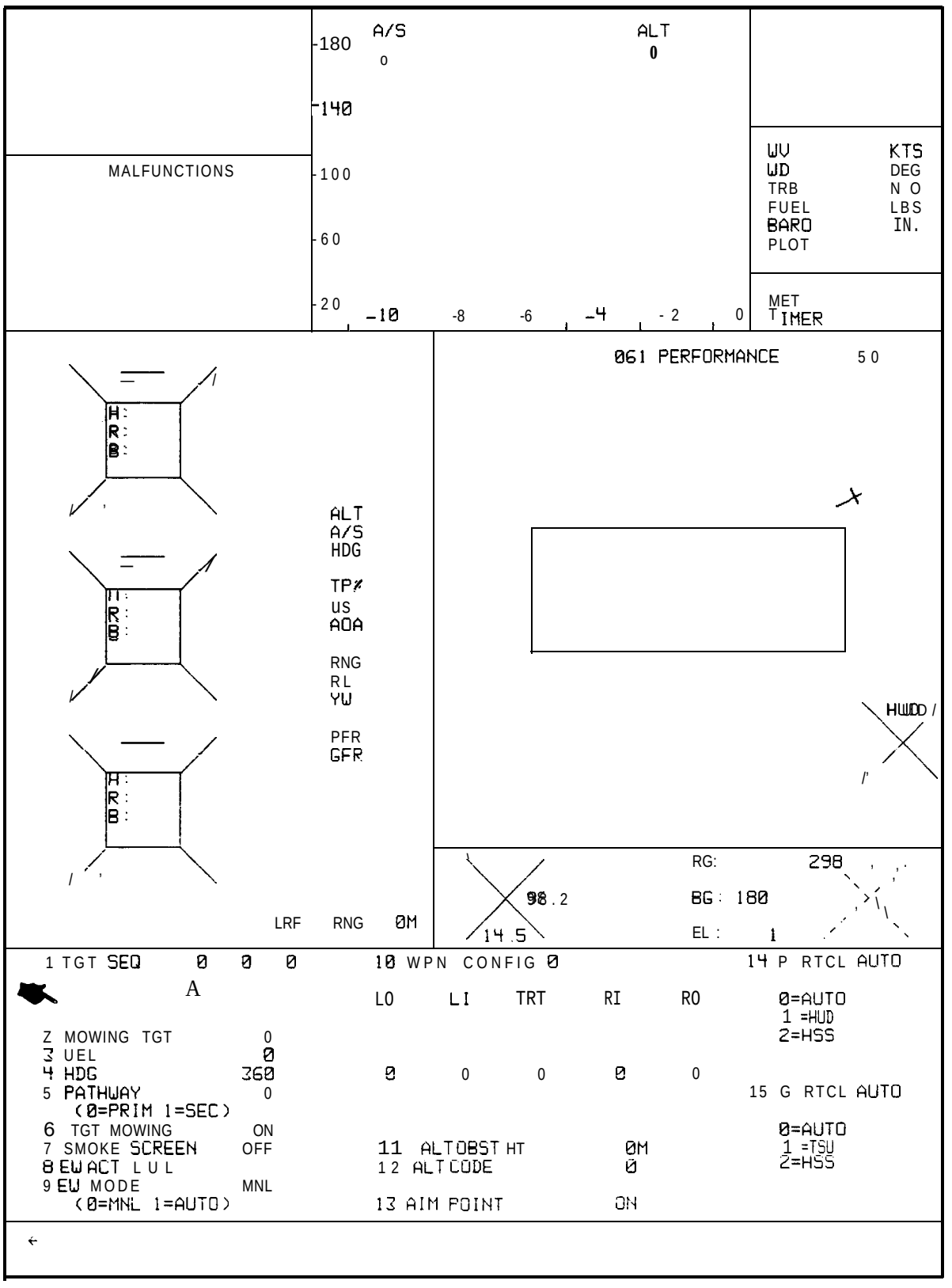


Figure 7-13. Performance Page 061

e. Helmet Sight Subsystem (HSS) Calibration. Two slightly different calibration procedures are utilized, depending upon the operating mode. Perform the appropriate procedure as required:

(1) Integrated mode. Calibration to each individual students helmet must be performed. For the integrated mode, perform the following steps:

NOTE

Helmets must be calibrated by both the pilot and gunner to have a completely aligned system.

(a) After initialization of IC set 02, release freeze.

(b) On page 61 of IOS CRT display, edit: line 2 (moving tgt.)0; line 10 (aim point) OFF.

(c) On page 20 of the IOS CRT display, set line 24 on. This puts a dot in the center of the visual display for each cockpit.

(d) The student pilot first centers the HSS reticle over the alignment dot and depresses the ACTION switch on the cyclic stick.

(e) The student gunner centers the HSS reticle over the alignment dot and depresses the ACTION switch on the cyclic stick.

(f) The alignment dot turns off for both the pilot and the gunner, completing the alignment for the integrated mode.

(g) If the alignment dot fails to turn off, the calibration procedure was not accurately performed. Should this occur, repeat the above steps.

(2) Independent mode. Calibration is accomplished following preceding steps (a) through (g), with the exception of (d) or (e) as appropriate.

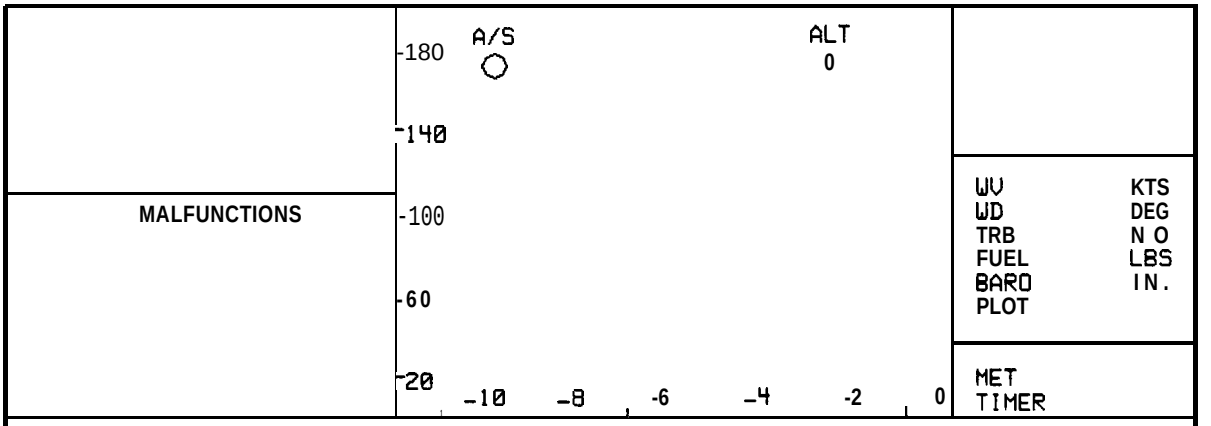
f. Target Selection. The instructor can call up the tactical map display for determining the selected target sequence, hostile ground fire, or electronic warfare area targets by typing page number 50, ENTER on the keyboard. With respect to the model board, the tactical map display shows the location of 26 targets available to be scored upon (represented as 1/8-inch lines with dots on one end) and the available TEP's and their fields of view (represented as right angles). The number by the TEP indicates the TEP number, and its position by the angle or line indicates (roughly) the TEP field of view. CRT page 23 lists the TEP's, their latitudes, longitudes, headings, and altitudes, and the targets that can be seen from each. (See figure 7-13.1.) The airfield is indicated by the small rectangle. The location of the helicopter is indicated by the cross within the circle, and the helicopter flightpath is shown by a dotted line as the simulated mission progresses. Moving target selection is indicated by two vertical lines within a circle, superimposed over the appropriate target number.

(1) Up to three targets in sequence can be entered by typing line 1, space, X_1, space, X_2, space, X_3, ENTER, where X is the selected target number in the category of 1 through 26. Any combination of numbers is allowed. The TARGET ADV switchlight provides sequential selection of the target of interest. Once scoring

information is present, the target sequence on CRT page 61 must be advanced to select the first in sequence before three new targets can be entered.

NOTE

FWS must be out of freeze condition to activate target advance.



023 TARGET ENGAGEMENT POINTS
TEP

TEP	LATITUDE	LONGITUDE	HDG (DEG)	ALTITUDE (MSL)	TO1
1	N031 06'27"	W097 44'04"	340	1215	FT 2 3 4 5 7 8 9
2	N031 07'05"	W097 43'01"	291	1313	F T 1 2 3 4 5 6 7 8 9
3	N031 06'59"	W097 42'49"	360	1079	FT10 11 12
4	N031 07'52"	W097 43'17"	360	1219	FT 5 6 7 8 9
5	N031 12'05"	W085 46'42"	282	1109	FT 13 14 15 16 17 18 19
6	N031 04'11"	W097 37'03"	360	1630	FT 16 17 18 19 20 21
7	N031 01'15"	W097 37'11"	319	1198	FT 13 19 20 24 25 26
8	N031 10'22"	W085 49'44"	047	964	FT 22 23 24 25 26
9	N031 07'05"	W097 43'01"	291	1312	FT 10 11 12

Figure 7-13.1 Target Engagement Points Page 023

(2) A moving target can be selected and edited on CRT page 50 or 61. Edit the appropriate line number for moving target. Edit the appropriate line number for velocity (up to 50 meters per second). If a TEP is selected (CRISP mode, CRT page 20), select a pathway (primary or secondary, CRT page 50 or 61, line 5). If the TEP selection is O (non-CRISP mode), edit the appropriate line number for heading (1 - 360 degrees). Activate target movement by editing line 3 on CRT page 50 or 61. Activation of the target advance switchlight will automatically reset the moving target to its point of origin.

NOTE

Moving target selected must match target of interest in target sequencing line.

(3) On page 61, a target aimpoint or video dot can be selected by typing line 10, space, 1, ENTER.

g. Visual Select. The pilot instructor can select forward visual, or forward and side visual for the pilot. The gunner instructor can select forward visual by actuating the desired switchlight on the VISUAL CONTROL panel. In the integrated mode, the gunner views the same scene as the pilots forward visual. In the independent mode, the forward visual is not available to the gunner if the pilot is using side visual.

(1) Day, dusk, or night and conditional lighting is controlled by editing the appropriate line on the visual conditions CRT page 21. (See figure 7-14.) When going from night or dusk to day lighting, no waiting period is necessary with the LSIG visual system. The MANUAL mode selection for lighting overrides initial conditions lighting mode.

(2) The VISIBILITY RANGE potentiometer on the IOS visual system panel can be changed at any time, with the approximate visibility range in feet indicated on CRT page 21.

h. Training Control and Monitor. Current flight conditions and environmental values can be continuously monitored on CRT page 20 as they pertain to the training exercise. (See figure 7-15.)

(1) During the course of a training exercise, current values are displayed for 11 flight parameters. These consist of altitude, airspeed, heading, roll angle, pitch angle, trim (yaw), vertical speed, torque pressure, rotor rpm percentage, rate-of-turn, and fuel quantity. Any one or more of these parameters, except torque pressure, can be frozen or released by keyboard entry.

(2) To freeze a parameter on lines 1 through 11 on CRT page 20, at the keyboard type the line number, space, * (asterisk character), ENTER. The asterisk symbol appears on the display adjacent to the line number indicating that the parameter has been frozen. To unfreeze or release the parameter, type the line number, space, ENTER.

(3) Current values are also displayed for environmental conditions. These line items, numbers 14 through 20 (figure 7-15), can be changed during the exercise by use of the CRT keyboard. Parameters that can be varied are: barometric pressure, outside air temperature, horizontal wind gust, wind velocity, wind direction, environmental sound level, and turbulence level. On CRT page 21, the

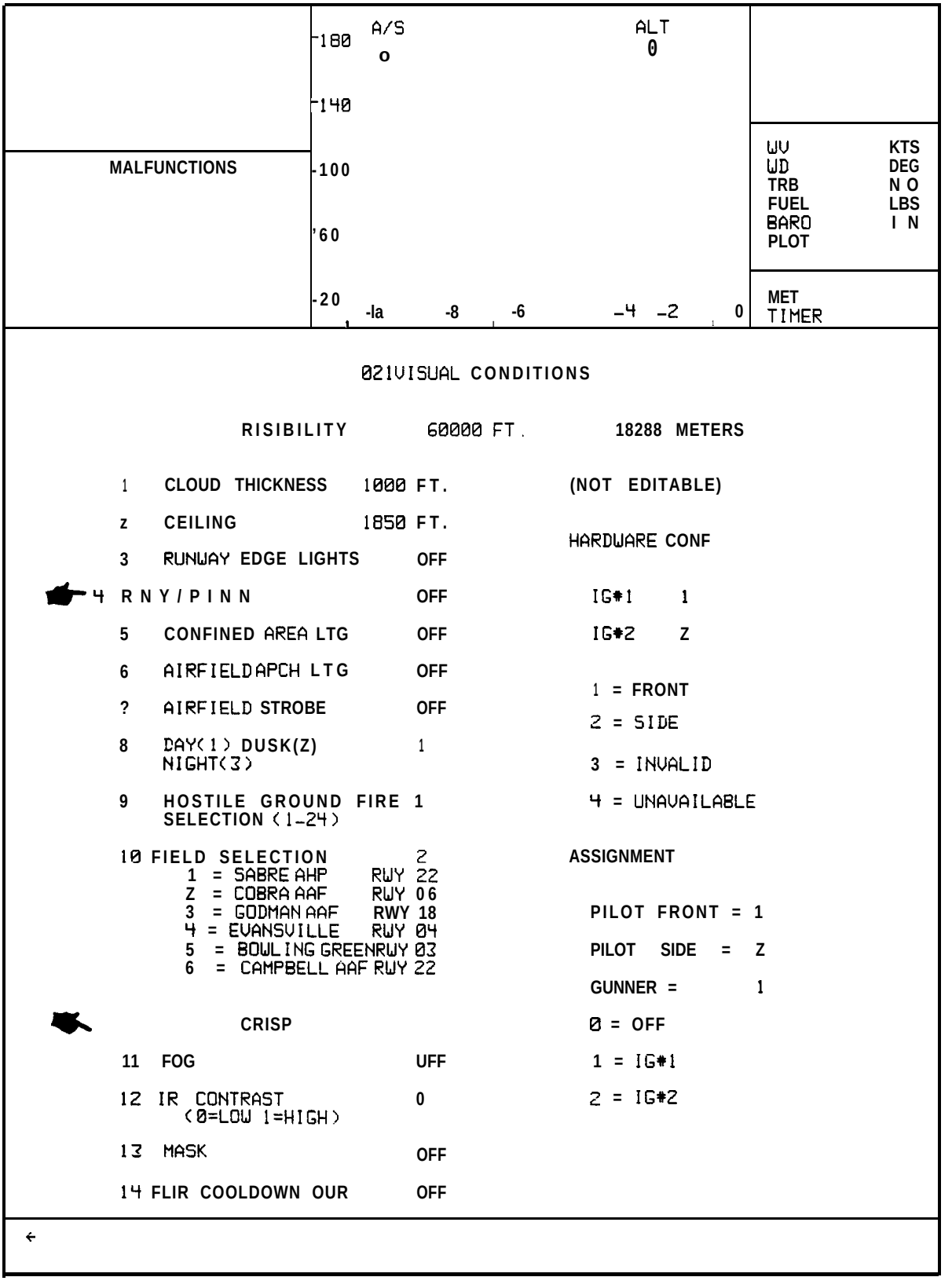


Figure 7-14. Typical Visual Conditions Page 021

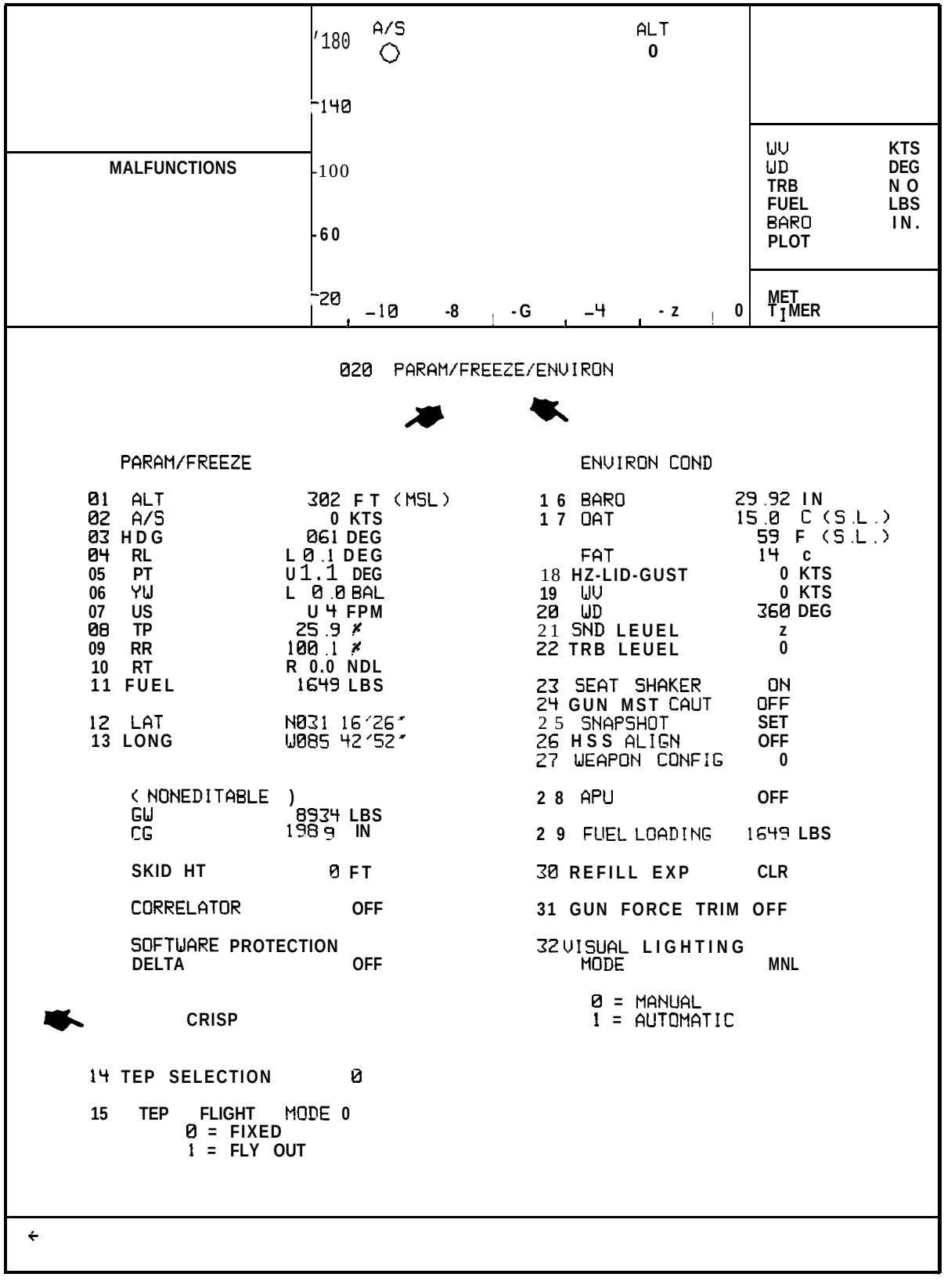


Figure 7-15. Typical Parameter/Freeze/Environment Page 020

visibility range, ceiling, cloud thickness, and day, dusk, or night condition are some of the other parameters that can be edited.

(4) To alter an environmental condition, enter via the keyboard the line number, space, desired value, ENTER. Set/clear and on/off conditions are edited using a numerical input of 1 for set or on, or a numerical input of 0 for off or clear.

NOTE

Visibility range on CRT page 21 is edited by adjusting visibility range potentiometer.

7-4. INITIALIZATION OF CHECKRIDE. There are four major categories of checkrides. Within each category, a checkride exercise can be selected. (See checkride CRT pages, figures 7-7 through 7-11.)

070 VFR Checkride
080 IFR Checkride
090 Tactical Weapons Checkride
100 Tactical Instrument Checkride

NOTE

Checkrides are not available to the gunner cockpit in the independent mode.

a. Should initialization be desired to a checkride, set appropriate category number on the thumbwheel (70, 80, 90 or 100) and depress INSERT. The FWS initializes automatically to the start of the selected checkride. When initial procedures and checks are completed by the crew, unfreeze the FWS to start the checkride. An automatic audio briefing describing the checkrides is provided when a checkride ending in zero is selected.

b. Checkrides that end in other than zero (exercises) can be selected individually. No audio briefings are provided with exercises. Up to nine exercises can be programmed in a checkride. Should a point be selected that does not exist, a message at the bottom of the CRT indicates ENTRY DOES NOT EXIST.

7-5. TERMINATION OF CHECKRIDE. The checkride automatically terminates at conclusion of the checkride, or if the instructor deletes the checkride.

7-6. INITIATION OF DEMONSTRATION. Prior to initiation of a demonstration, ensure that engine is running at operating rpm percentage. The environmental, visibility range, and sound level to be used during demonstration should be edited on CRT pages 20 and 21. Then, while the simulator is frozen, dial the selected demonstration number from the CRT INDEX page on the thumbwheel selector and depress INSERT. When initialization is complete, unfreeze to start the demonstration. Synchronized demonstration audio commentary is available when a demonstration is selected. Should a point be selected that does not exist, a message at the bottom of the CRT indicates ENTRY DOES NOT EXIST.

7-7. TERMINATION OF DEMONSTRATION. Demonstrations terminate automatically at conclusion. They can be manually interrupted and terminated by dialing demonstration number on the thumbwheel selector and depressing DELETE switchlight.

Section II. INITIAL CONDITIONS

7-8. GENERAL . The flight weapons simulator has 10 preprogrammed initial condition (IC) sets available for assignment as a setup or reset point for training exercises. A selected IC set can be modified by transposition to IC set 011, edited as desired, and inserted via the three-digit thumbwheel as IC 011 (refer to paragraph 7-3 (b)).

a. During initialization, the computer establishes the FWS at the geographic location of the latitude and longitude of the selected IC set. Simultaneously, conditions of appropriate flight control positioning, flight parameters, and environment will be achieved. The 10 preprogrammed IC sets are listed on CRT display pages shown in figures 7-2 and 7-3. A typical IC set page is shown in figure 7-1.

b. The process of calling up a preprogrammed IC set is described in paragraph 7-3. Any preprogrammed IC can be directed to IC set 11 where it can be revised prior to insertion as previously described. During the initialization process, the computer drives controls as required to achieve the demanded steady-state airspeed, altitude, and heading before leaving the freeze condition from which a student can proceed.

NOTE

During editing, IC flight parameters cannot be set to exact values and are subject to software control modification within the allowable tolerances given below. The flight parameters not listed on the IC pages, such as roll, pitch, yaw, torque, and rate-of-turn, assume whatever values are necessary to trim the aircraft to the conditions specified by the inserted IC.

Altitude	±10 feet
Airspeed	± 2 knots
Heading	± 2 degrees
Vertical speed	± 100 feet per minute
RPM	± 2%
Fue 1	± 10 pounds

c. If a TEP is selected and IC page 11 is inserted, the simulated aircraft position is initiated at the coordinates and altitude listed for the selected TEP on CRT page 23. Other items that are initialized when a TEP is selected are heading, airspeed (set to O), and vertical speed (set to O). The flight controls are set trimmed to a stable hover condition.

Section III. INSTRUCTOR STATION CONTROLS AND FUNCTIONS

7-9. GENERAL . Figures 2-2 through 2-4 show the locations of the student and instructor/operator station (IOS) control panels. Locations of controls on the IOS control panels are shown in figures 7-16 through 7-23. Figure 7-24 shows the lay out of controls on the student control panels. Controls on the student control panels are electrically connected in parallel, having the same capabilities as the controls at the IOS.

a. The figures and accompanying text that follow, list each control, its location and type, and the function of each switch. This information should be utilized by the instructor/operator to become initially familiar with the control panels. It can then be used as a reference until full familiarity is achieved. Further information is provided in paragraph 7-36 regarding the thumbwheel and keyboard utilization.

b. One rule that must be followed when operating the FWS is to initiate the command, wait for it to be executed, verify that the function or parameter has changed to the new and correct value, and then proceed to the next step. This is especially true when operating the CRT keyboard, thumbwheel number select, and insert switchlights. The scratchpad area at the bottom of the CRT display allows verification of keyboard inputs prior to their actual entry. This area also displays error messages for incorrectly executed entries of either thumbwheel or keyboard inputs.

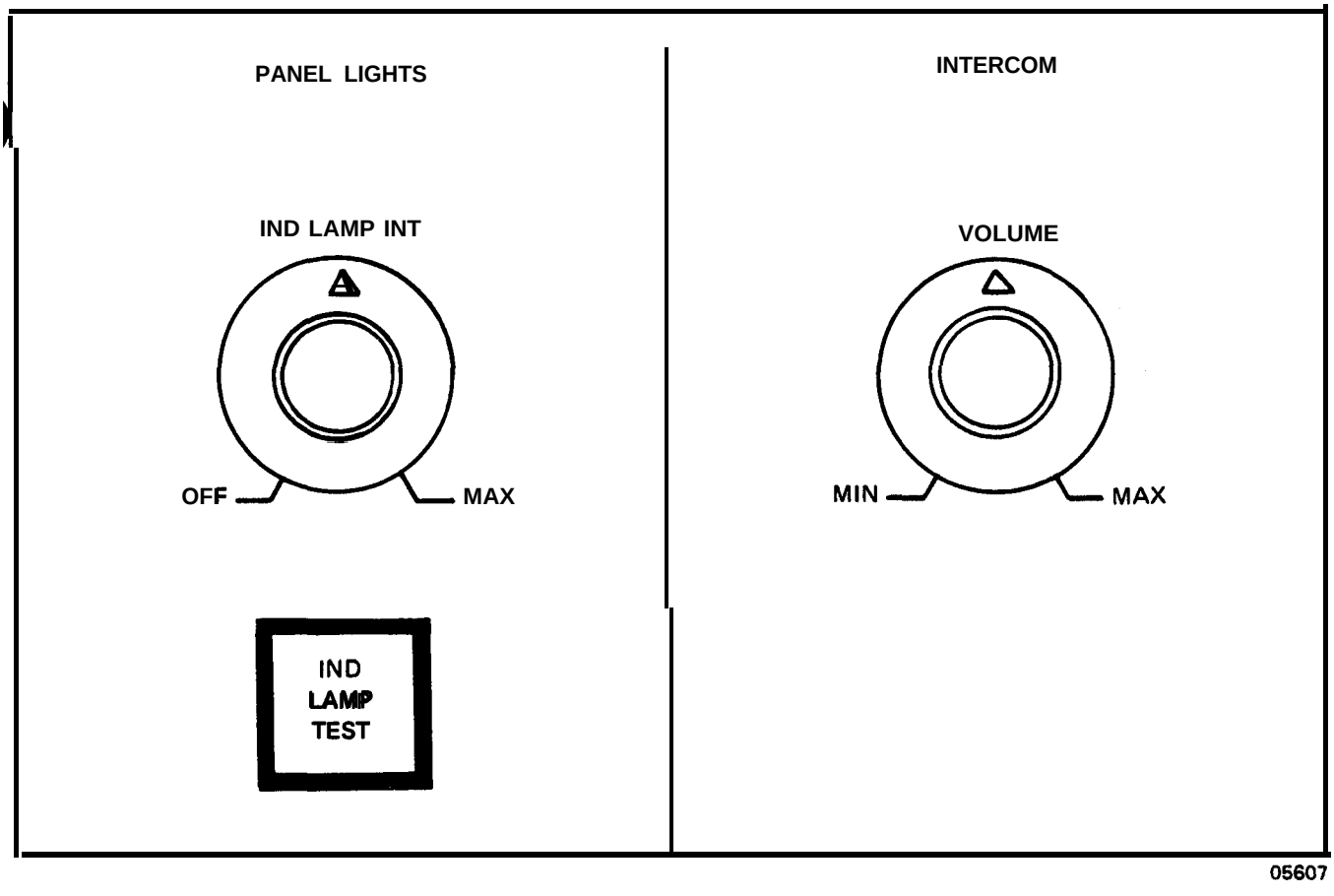
c. The IOS console indicators and switchlights have been color coded, based on the following:

(1) Green illuminated nomenclature represents an active system, i.e., MOTION ON, CONTROL LOADING ON, etc.

(2) Red illuminated background denotes an emergency control, i.e., EMERGENCY STOP .

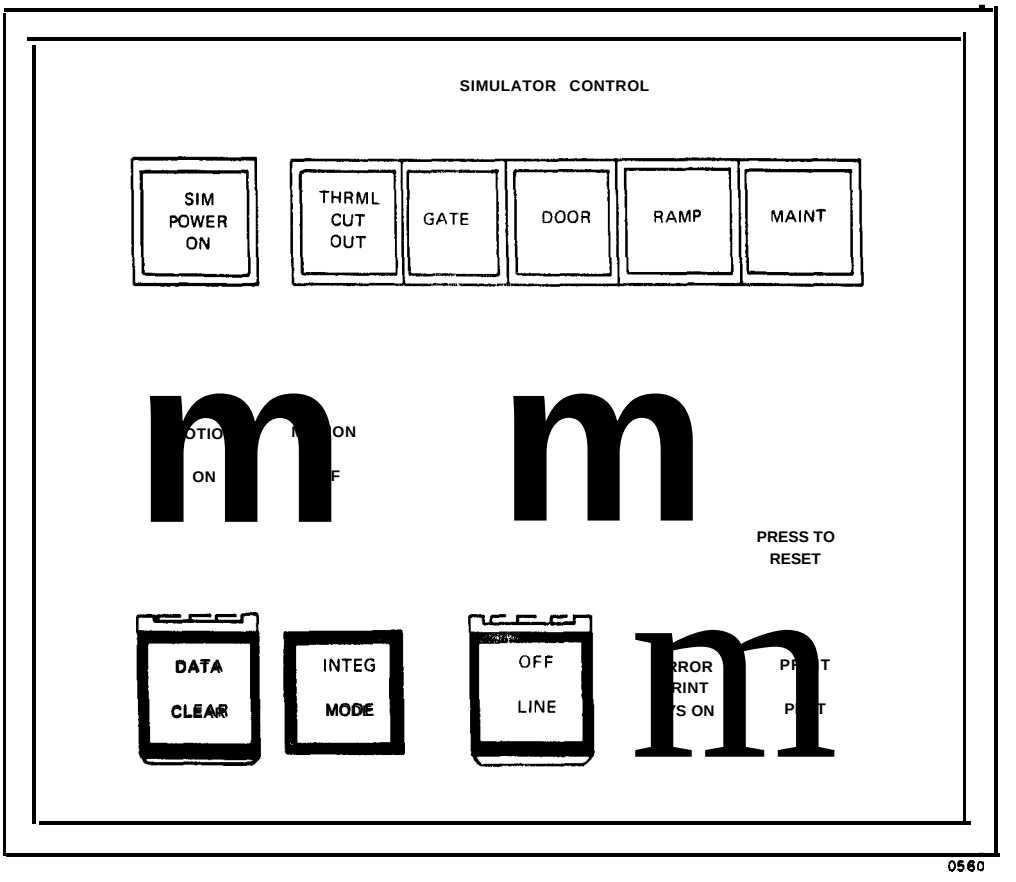
(3) Yellow illuminated nomenclature represents an FWS alert, i.e., failure of motion interlocks to be satisfied.

(4) White illuminated nomenclature represents status indications, positions or conditions of FWS control such as: PROBLEM FREEZE, RESET, VHF NAV COMM, etc.



Nomenclature	Function
IND LAMP INT control (single-turn potentiometer)	Permits instructor to vary intensity of indicator lights and switchlights on IOS control panels and student control panels. This control is operable at both stations in either independent or integrated mode.
IND LAMP TEST switchlight	When depressed and held for test, illuminates all indicator lamps on IOS control panels and student control panels to verify bulb operation. This control is operable at both stations in either independent or integrated mode.
VOLUME control (single-turn potentiometer)	Permits instructor to vary sound level to headset. This control is operable at both stations in either independent or integrated mode.

Figure 7-16. Panel Lights and Intercom Panels



Nomenclature	Function
SIM POWER ON indicator	Indicates status of FWS system master power switch. Power is turned on at main power cabinet in computer rmm. When power is turned on, both simulators have power and capability for motion.
Motion interlocks (group of 5 indicators)	Indicate status of interlocks. Motion platform cannot operate when any interlock is open. Each motion interlock system is independent, whether in integrated or independent mode.
THRML CUT OUT	Indicates that thermal cutout interlock on hydraulic pumping unit is open. Respective motion system will be deactivated.
GATE	Indicates that gate from computer floor to floor underneath motion platform is open. Both motion systems will be deactivated.
DOOR	Indicates that cockpit door is not locked. Respective motion system will be deactivated.

Figure 7-17. Simulator Control Panel (Sheet 1)

Nomenclature	Function
Motion interlocks - continued	
RAMP	Indicates that boarding ramp is not up in stowed position. Respective motion system will not operate.
MAINT	Indicates that motion system has been placed in a maintenance mode by operation of the SYSTEM CONTROL keyswitch at the motion system cabinet. In this mode, motion system is controlled only from motion system cabinet.
MOTION ON **switchlight**	Activates motion system, provided that interlocks are satisfied. **Switchlight** blinks during motion system transition to neutral position. When motion reaches neutral position, **switchlight** reverts to steady on. On **IOS** console, SIM POWER ON must be on for this **switchlight** to operate. Interlock function includes **access ramp.** After switch **actuation,** boarding ramp rises and clears motion platform before motion becomes operational. Prior to responding to mission flight control inputs, motion platform erects to neutral position. Neutral position is a point at which the hydraulic cylinder legs are extended approximately halfway. Operation of this **switchlight** is not mode-dependent.
MOTION OFF **switchlight**	Deactivates motion platform. Motion platform returns at controlled rate to neutral position prior to reaching settled position. This **switchlight** is lit when motion is off. Upon settling of motion system, boarding ramp is lowered and aligns with motion platform. Operation of this **switchlight** is not mode-dependent.
CONT LOAD ON **switchlight**	Activates valve that directs hydraulic pressure to control loading system. **Switchlight** is lit when control loading is on. Operation of this **switchlight** is not **mode-**dependent.
CONT LOAD ***OFF*** **switchlight**	Activation closes valve through which hydraulic pressure is supplied to control loading system. This **switchlight** is illuminated when control loading is off. Operation of this switchlight is not **mode-**dependent.

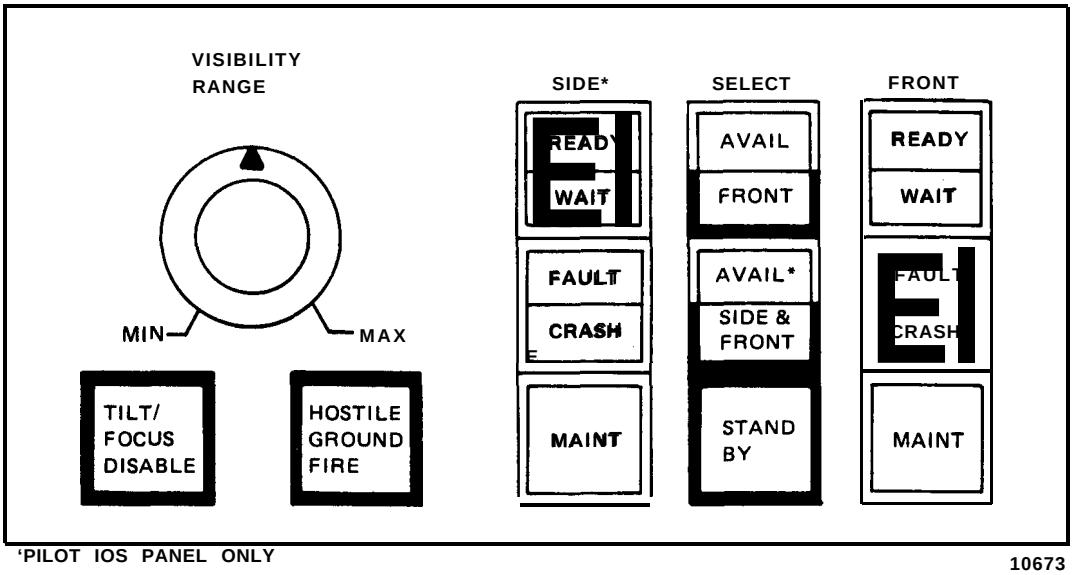
Figure 7-17. Simulator Control Panel (Sheet 2)

Nomenclature	Function
CONT LOAD LOCKED **switchlight**	Illuminates to indicate an abnormal operating condition **or** fault in control loading system. Cockpit flight controls lock up, preventing any further movement. Once fault is cleared, activation of **switchlight** extinguishes light and resets system. Operation of this control is not mode-dependent.
DATA CLEAR **switchlight**	Clears all data accumulated during previous training session. Initializes trainer to clean conditions. Activation of this **switchlight clears** track history, **clears** out-of-tolerance table, removes all active malfunctions, clears mission elapsed time (MET) CRT indication, restores all frozen parameters to unfrozen condition, and initializes all displays. In integrated mode, this **switchlight** at gunner instructor station functions only as indicator light.
INTEG MODE **switchlight**	Activation by pilot instructor/operator allows an integrated mission to be flown. **Deactuation** returns both cockpits to independent operation. **NOTE** Selection of this mode should first be coordinated with maintenance personnel using communications system. The changeover can cause delay of approximately 10 minutes. This mode can be entered only when both cockpits are in manual mode freeze condition. If gunner cockpit is not frozen, gunner and pilot instructor INTEG MODE indicator lights blink. Both indicators illuminate steadily during integrated mode operation.

Figure 7-17. Simulator Control Panel (Sheet 3)

Nomenclature	Function
OFF LINE **switchlight**	Enables instructor to use computer in off-line mode for printing out stored plots for both cockpits in an uninterrupted manner. However, it is not necessary to switch off-line to obtain hardcopy data. Activation of this **switchlight** a second time returns FWS to on-line freeze mode and extinguishes light. CAUTION To avoid any possibility of visual system damage, notify visual personnel of the off-line status. NOTE For independent mode, both cockpits must be in freeze to go off-line. If both cockpits are not in freeze condition, activation of either OFF LINE switchlight only causes FREEZE switchlight to blink at the other **IOS** console. When both are in freeze condition, system can be put in off-line mode from either cockpit via OFF-LINE switchlight. Once in off-line, either cockpit can request off-line processing. The system can be taken out of off-line mode at any time by depressing OFF LINE **switchlight** and holding down until light goes out.
ERROR PRINT SYS ON switchlight	When simulator is on-line, activation results in student performance deviations in excess of aircraft not-to-exceed values **(VNE)** to be printed out as they occur. During an exercise, this **switchlight** also controls printing of checkride exercise parameters. During checkride, both VNE and checkride parameters are printed automatically. In integrated mode, this switchlight at gunner instructor station functions only as an indicator light.
PRINT PLOT **switchlight**	In off-line or on-line modes, permits either instructor to print out stored snapshots (up to 20 combined total for pilot and/or gunner cockpit) .

Figure 7-17. Simulator Control Panel (Sheet 4)



Nomenclature	Function
VISIBILITY RANGE control (single-turn potentiometer)	Permits instructor to vary visibility of through-the-window visual scene from unlimited (maximum) to full haze (minimum). Also affects CRISP scene in TSU. (Does not affect FLIR or symbolic scenes.)
TILT/FOCUS DISABLE switchlight	Illuminates when turned on, disabling Scheimpflug focus correction (tilt) of probe. This provides an alternate focus curve for low-level, close-to-vertical objects focusing. This is not an optimum focus correction for general flying and it is up to instructor/operator to determine when this feature should be used. Instructor selection of this focus mode at low altitude levels can cause a noticeable out-of-focus condition during the 2- to 3-second transition period. Selection at higher altitude will result in a less noticeable out-of-, focus condition during the transition period.

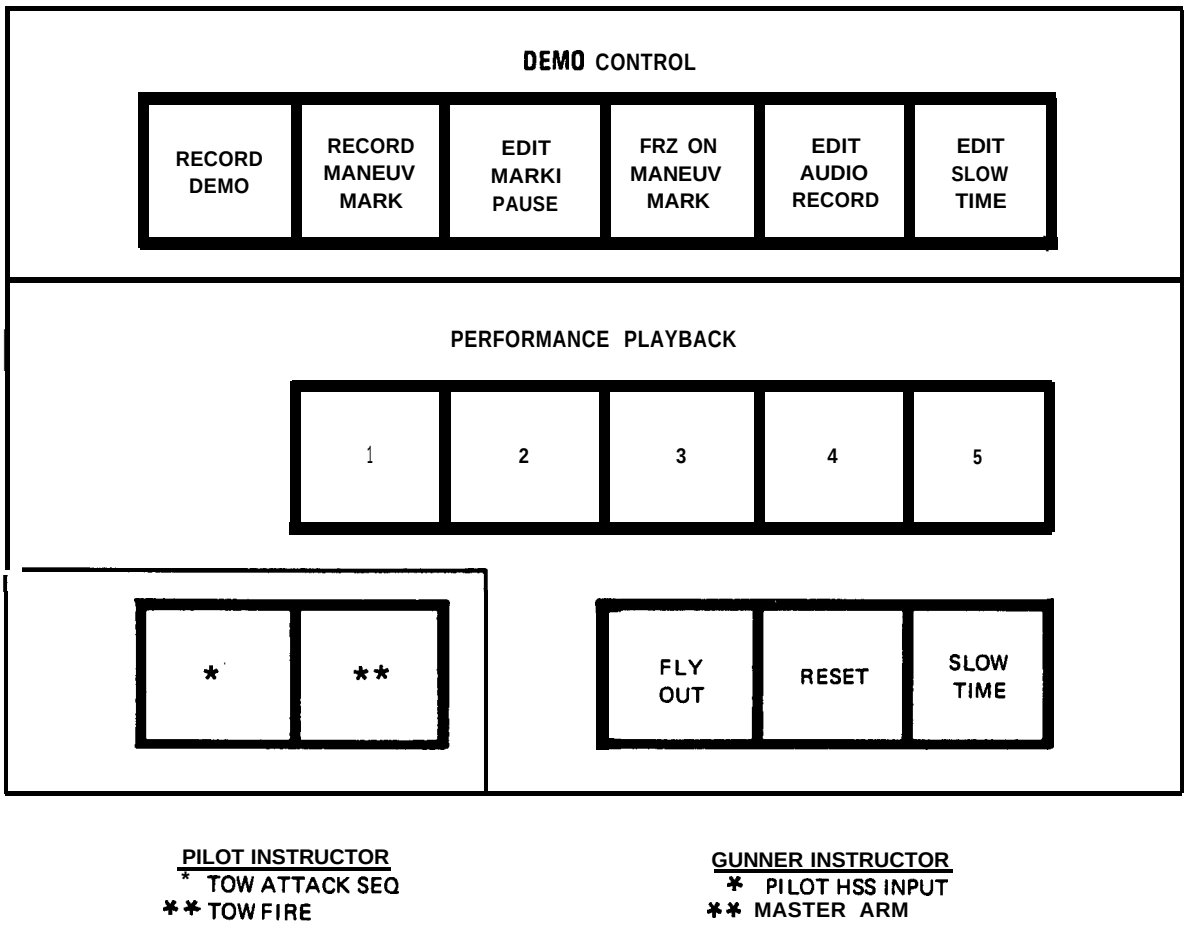
Figure 7-18. IOS Visual System Panel (Sheet 1)

Nomenclature	Function
	CAUTION Avoid prolonged engagement (in excess of 3 to 5 seconds duration) of HOSTILE GROUND FIRE switchlight to avert system damage.
HOSTILE GROUND FIRE momentary-action switchlight	When depressed and held, enables hostile ground fire from a preselected site on model board that must be in view on visual scene. When activated, results in flashing red spot in the general area of weapon site. Due to positioning accuracy, the spot may appear to move with respect to model features.
SIDE READY/WAIT (pilot IOS only), FRONT READY/WAIT split-lens indicator	Allows instructor to determine when visual system is in a usable mode (READY) or is in a mode which will require a period of time before a visual scene is presented (WAIT). WAIT indicator illuminates when a visual reset is in progress or any gantry axis is beyond model board boundaries.
SIDE FAULT/CRASH (pilot IOS only), FRONT FAULT/CRASH split-lens indicator	Provides two modes of status notification. When illuminated steadily, reset is possible from IOS by returning system to operate mode. When flashing, reset is not possible, and visual personnel must be notified of a problem. FAULT indicates when any visual system fault has occurred, placing system in standby. CRASH indicates that visual system detected crash. Visual maintenance personnel should be notified at the time this occurs and for repeating fault/crash indications (steady illumination). Resetting without notifying visual personnel may destroy data, making it difficult or impossible to find the problem cause at a later time.
SIDE MAINT (pilot IOS only), FRONT MAINT status indicator	Denotes that visual system is in a pure maintenance mode and is not available to cockpit. Flashing indicates that visual system is on-line with computer, visual system test box is ON, and visual is not available for training.

Figure 7-18. IOS Visual System Panel (Sheet 2)

Nomenclature	Function
SELECT AVAIL/FRONT switchlight/ind icator	When AVAIL portion illuminates, it indicates that front window visual is available. By depressing switch so that lower half (FRONT) illuminates, setup for front window becomes dedicated to that student station in independent mode. In integrated mode, the same visual scene is assigned to both pilot and gunner front window.
SELECT AVAIL/ SIDE & FRONT (pilot IOS only) switchlight/indicator	When AVAIL portion is illuminated, it indicates that both front and side window are available for use. Depressing switch so lower half illuminates assigns both visual systems to pilots cockpit for both a front and side window display. In independent mode, this results in no visual system being available to gunner. In integrated mode, gunner has the same forward visual available as the pilot.
STAND BY switchlight	When depressed so that it illuminates, whichever visual system assigned to pilot cockpit is placed in an off-line mode with display blanked. In independent mode, visual system assigned to pilot station remains until released by use of AVAIL/FRONT or AVAIL/SIDE & FRONT switches. (Gunner station cannot select.) In integrated mode, STANDBY function places both pilot and gunner visual system in an off-line mode.

Figure 7-18. IOS Visual System Panel (Sheet 3)



Nomenclature	Function
RECORD DEMO alternate-action switchlight	Allows instructor to generate a demonstration program assigned to demonstration number inserted in thumbwheel. FREEZE switchlight blinks until FWS is ready and then goes steady. Unfreezing starts demonstration recording of simulator performance as flown. Old demonstration is erased as new recording is made. Demonstrations can be prepared only in integrated mode. Gunner and pilot instructor controls operate in parallel. Once recorded,

Figure 7-19. Demonstration Control and Performance Playback Panel (Sheet 1)

Nomenclature	Function
	demonstrations can be given in either integrated or independent mode. Refer to Chapter 8, Section II for Demonstration Edit and Formulation.
RECORD MANEW MARK momentary-action switchlight	Permits instructor/operator to prepare a demonstration in segments to facilitate editing of demonstration. When creating demonstration, activation of this switchlight stores flight parameters for subsequent reset. RECORD MANEW MARK is operational only in RECORD DEMO mode. Maneuver marks appear on ground track.
EDIT MARK/PAUSE dual-function momentary-action switchlight/ indicator	When depressed during recording of demonstration, maneuver being recorded is indexed. During audio editing only, FWS enters freeze condition upon reaching these indexed points. When lit during audio editing of demonstration, prerecorded maneuver stops, but audio recorder continues to operate in record mode at normal speed. This permits interruption of demonstration playback without interruption of recording of an audio accompaniment. Once pauses and audio commentary are edited into demonstration? they remain there as a permanent part of that demonstration.
FRZ ON *MANEW MARK* alternate-action switchlight	Causes FWS to freeze whenever a maneuver mark is encountered. In RECORD DEMO mode, whenever RECORD MANEW MARK is activated, simulator freezes. In EDIT AUDIO RECORD mode, whenever a previously recorded maneuver mark is encountered, simulator freezes.
EDIT AUDIO RECORD alternate-action switchlight	Permits instructor/operator to edit or add new audio to demonstration number inserted via thumbwheel. Old audio is erased as new audio is recorded.

Figure 7-19. Demonstration Control and Performance Playback Panel (Sheet 2)

Nomenclature	Function
EDIT SLOW TIME alternate-action switchlight	Used in EDIT AUDIO RECORD mode to insert slow-time into demonstration. Audio tape recorder continues to operate at its normal speed, thus permitting instructor to add commentary during slow-time. A second depression of this switch terminates slow-time. Once slow-time and audio commentary are edited into demonstration, they remain there as a permanent part of that demonstration. WARNING Alert pilot and gunner to clear all controls prior to initialization. Abrupt movement of controls by the computer may cause injury.
1,2,3,4,5, (Performance PLAYBACK) switchlights	This set of switchlights commands and indicates playback of current FWS response to student performance in l-minute increments up to 5 minutes prior in time. Depressing desired performance playback switchlight number causes FREEZE switchlight to blink until simulator is reset for playback. FREEZE then goes steady. Audio playback status is indicated on edit line of CRT. By unfreezing simulator, playback begins at start of minute(s) selected - counting back minutes of recorded flight from the time playback was called for. When playback selection is made, the light in that number switch illuminates until that minute is completed, at which time next lower number illuminates and so forth until simulator is at the latest recorded point. Simulator then freezes and awaits further instructions. In integrated mode, this switchlight at gunner IOS functions only as an indicator light.
FLY OUT switchlight	Activation terminates 1- to 5-minute current playback and permits student to fly simulator from the point where playback just ended. In integrated mode, this switchlight at gunner IOS functions only as an indicator light.

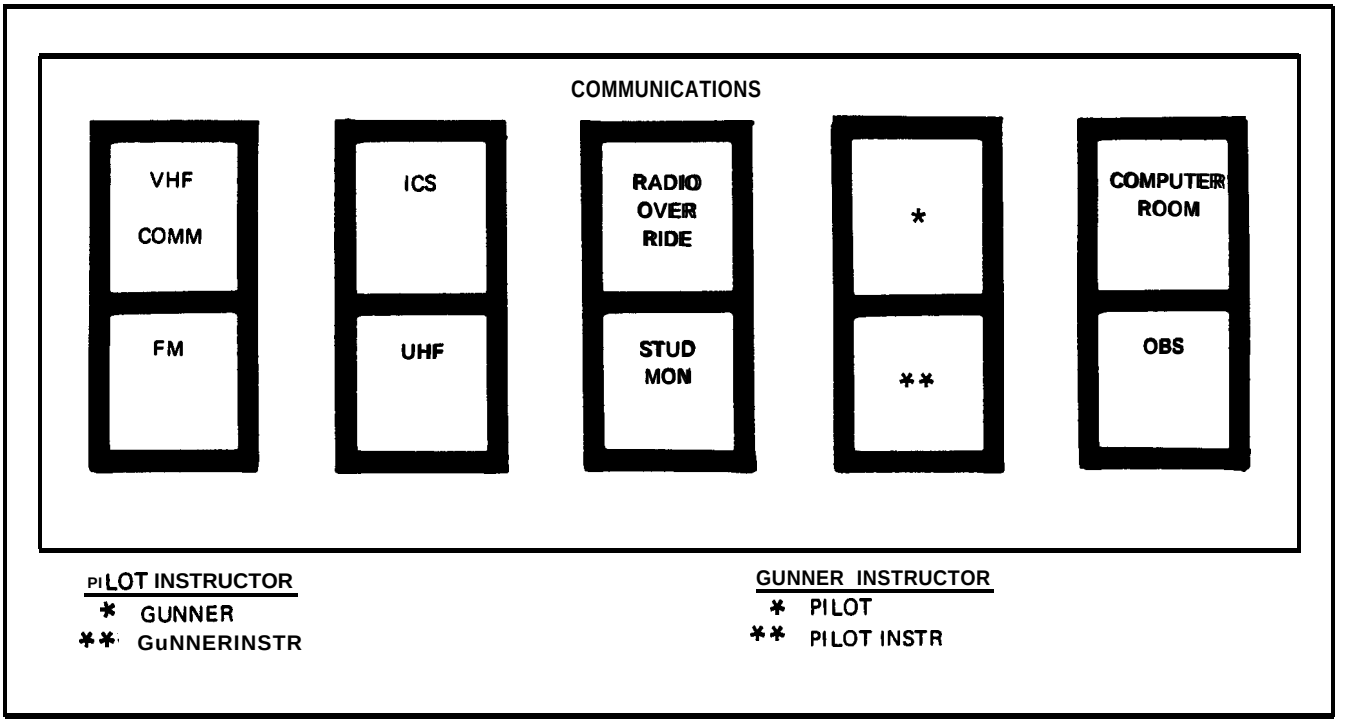
Figure 7-19. Demonstration Control and Performance Playback Panel (Sheet 3)

Nomenclature	Function
RESET momentary-action **switchlight**	When depressed at any time during the current **1-** to **5-minute** performance playback, returns simulator to exactly where it was when playback was initiated. Activating during performance playback terminates playback, and returns simulator to where it was when playback was initiated, during which time FREEZE **switchlight** flashes. When returned to point of initiation, FREEZE switchlight illuminates steadily. The FWS is then ready to continue where it left off by pressing FREEZE. In integrated mode, this switchlight at gunner **IOS** functions only as an indicator light.
SLOW TIME momentary-action **switchlight**	When depressed during performance playback, causes FWS to operate at one-half normal speed. Second depression causes the FWS to return to normal speed operation. There is no audio during slow-time. In integrated mode, this switchlight at gunner **IOS** functions only as an indicator light.
TOW ATTACK SEQ (pilot **IOS** only) momentary-action **switchlight**	Used in independent mode to permit pilot instructor to make an input to pilot that would normally be received from gunner. Depressing TOW ATTACK SEQ shows a presentation on HUD of a TOW missile selected for launch as if gunner had performed the operation.
TOW FIRE (pilot **IOS** only) momentary-action **switchlight**	Used in independent mode to permit pilot instructor to make an input to pilot that would normally be received from gunner. Depressing TOW FIRE fires a TOW missile (assuming launch conditions have been met) and shows a post-launch presentation on HUD. Maneuver limits are the actual system limits until missile impact or wire cut, whichever occurs first.
PILOT **HSS** INPUT (gunner **IOS** only) momentary-action **switchlight**	Used in independent mode to permit gunner instructor to make an input to gunner that would normally be received from pilot. Activation of this switch causes simulated pilot helmet sight subsystem **(HSS) line-of-**sight, which is directed at a selected target-of-interest, to automatically redirect turret and/or telescopic sight unit **(TSU)** to the same target-of-interest following activation of the PHS **ACQ** switch.

Figure 7-19. Demonstration Control and Performance Playback Panel (Sheet 4)

Nomenclature	Function
MASTER ARM (Gunner IOS only) momentary-action switchlight	Used in independent mode to permit gunner instructor to make an input to gunner that would normally be received from pilot. This switch has the same effect as pilot master arm switch. This is a 3-state presentation: OFF simulates master arm switch in off position, flashing simulates master arm switch in STBY position, ON simulates master arm switch in ARM position. Transition is from OFF to STBY, then to ARM and OFF with successive activations by instructor/ operator. NOTE Initiation of any mode change or selecting AUTO FLIGHT automatically sets this switch to OFF.

Figure 7-19. Demonstration Control and Performance Playback Panel (Sheet 5)



Nomenclature	Function
VHF COMM **switchlight**	Permits instructor to communicate with crew over VHF/AM radio set, using **XMIT** on headset cord switch.
ICS (intercommunication system) **switchlight**	Permits initiating instructor to communicate with crew over simulated aircraft ICS network, using **ICS** on headset cord switch.
RADIO OVERRIDE **switchlight**	Permits instructor to talk to crew without regard to radio control settings. In integrated mode, RADIO OVERRIDE **switchlight** at gunner **IOS** station functions only as an indicator light. Use either **XMIT** or **ICS** on headset cord switch. This function is **one-**way communication from instructor to crew and cannot be used simultaneously with ICS **switchlight.** If both **switchlights** are **selected,** only **IC** operates.

Figure 7-20. Communications Panel (Sheet 1)

Nomenclature	Function
GUNNER (pilot IOS only) switchlight	Permits pilot instructor to override aircraft ICS system to talk to gunner in independent mode, using either XMIT or ICS on headset cord switch. When GUNNER and ICS switchlights are both selected, only ICS operates. NOTE This function is necessary for pilot instructor to coordinate switching from independent to integrated mode.
PILOT (gunner IOS only) switchlight	Permits gunner instructor to override aircraft ICS system to talk to pilot in independent mode, using either XMIT or ICS on headset cord switch. When PILOT and ICS switchlights are both selected, only ICS operates.
COMPUTER ROOM switchlight	Permits instructor to talk with computer room personnel. When instructor initiates a call to or receives a call from the computer room, this switchlight blinks until call is answered, at which time light goes on steadily. When instructor initiates a call, an alerting bell rings in computer room.
FM switchlight	Permits instructor to communicate to crew over VHF/FM radio set, using XMIT on headset cord switch.
UHF switchlight	Permits instructor to communicate to crew over UHF radio set receiver, using XMIT on headset cord switch.
STUD MON switchlight	Permits instructor and observer to monitor all crew communications without regard to other crew and instructor communication control settings.
GUNNER INSTR (pilot IOS only) switchlight	Permits pilot instructor to communicate with gunner instructor, using ICS on headset cord switch. When pilot instructor initiates or receives a call, this switchlight blinks until call is answered. Switchlight then goes on steadily. COMPUTER ROOM switchlight is disabled if this function is already in use.

Figure 7-20. Communications Panel (Sheet 2)

Nomenclature	Function
PILOT **INSTR** (gunner **IOS only**) **switchlight**	Permits gunner instructor to communicate with pilot instructor, using ICS hot microphone operation. When gunner instructor initiates or receives a call, this **switchlight** blinks until call is answered. **Switchlight** then goes on steadily. COMPUTER ROOM **switchlight** is disabled if this function is already in use.
OBS (observer) **switchlight**	Permits instructor and observer to talk with each other privately. Instructor and observer have hot microphone operation. Observer can monitor what instructor hears by selecting receiver switch 4 on observer **ICS** unit. When actuated in conjunction with COMPUTER ROOM **switchlight**, enables three-way conversation between computer room, instructor, and observer.

Figure 7-20. Communications Panel (Sheet 3)

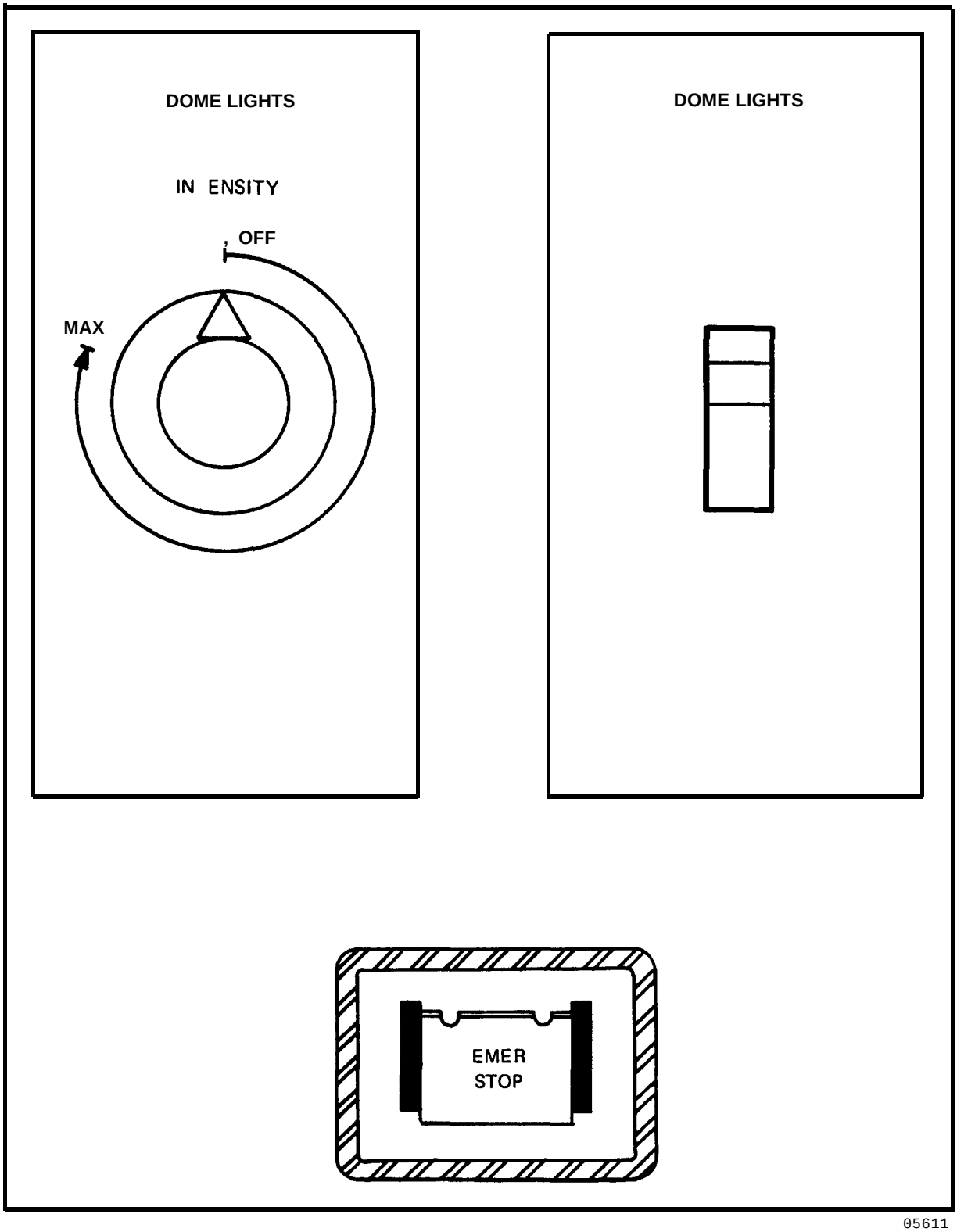
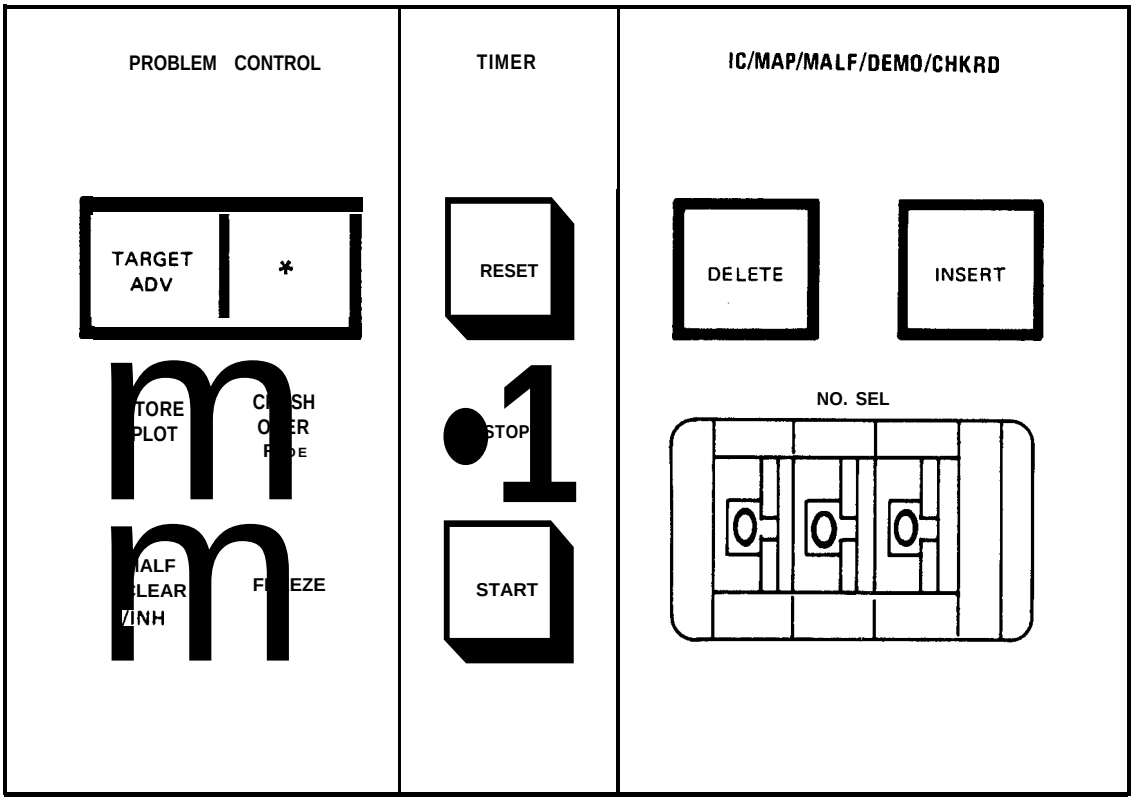


Figure 7-21. Dome Lights and Emergency Stop Control and Switches (Sheet 1)

Nomenclature	Function
INTENSITY DOME LIGHTS (OFF-MAX) single-turn dimmer control	Provides variable intensity control of overhead fluorescent lighting
DOME LIGHTS (on/off) wall lightswitch	Permits on/off control of overhead fluorescent lighting. Located adjacent to compartment entrance door and overrides setting of variable INTENSITY DOME LIGHTS control.
EMER STOP switchlight	When depressed, turns off all power to FWS. This switchlight is guarded with black barriers and a spring-loaded clear cover to prevent inadvertent actuation. The switchlight is illuminated when power is ON. All EMER STOP controls throughout simulator complex are functional at all times (lit red) regardless of simulator mode.
FOOT LIGHTS (on/off) wall lightswitch	Permits on/off control of low-intensity footlights. Located adjacent to compartment entrance door.

Figure 7-21. Dome Lights and Emergency Stop Controls and Switches (Sheet 2)



Nomenclature	Function
TARGET ADV **switchlight**	Directs computer to use next target selected as a basis for weapon scoring. Target advancement cannot be accomplished with FWS in freeze mode.
GUNNER CONT (pilot **IOS** only) **switchlight**	When operating in integrated mode, permits transfer of flight control to gunner station. Remains lit while in this mode. Does not function in independent mode.
AUTO FLIGHT (gunner **IOS** only) **switchlight**	Permits gunner instructor to use pilot portion of a demonstration for gunner training. Pilot portion of demonstration flies gunner cockpit while gunner trains in specific tasks.

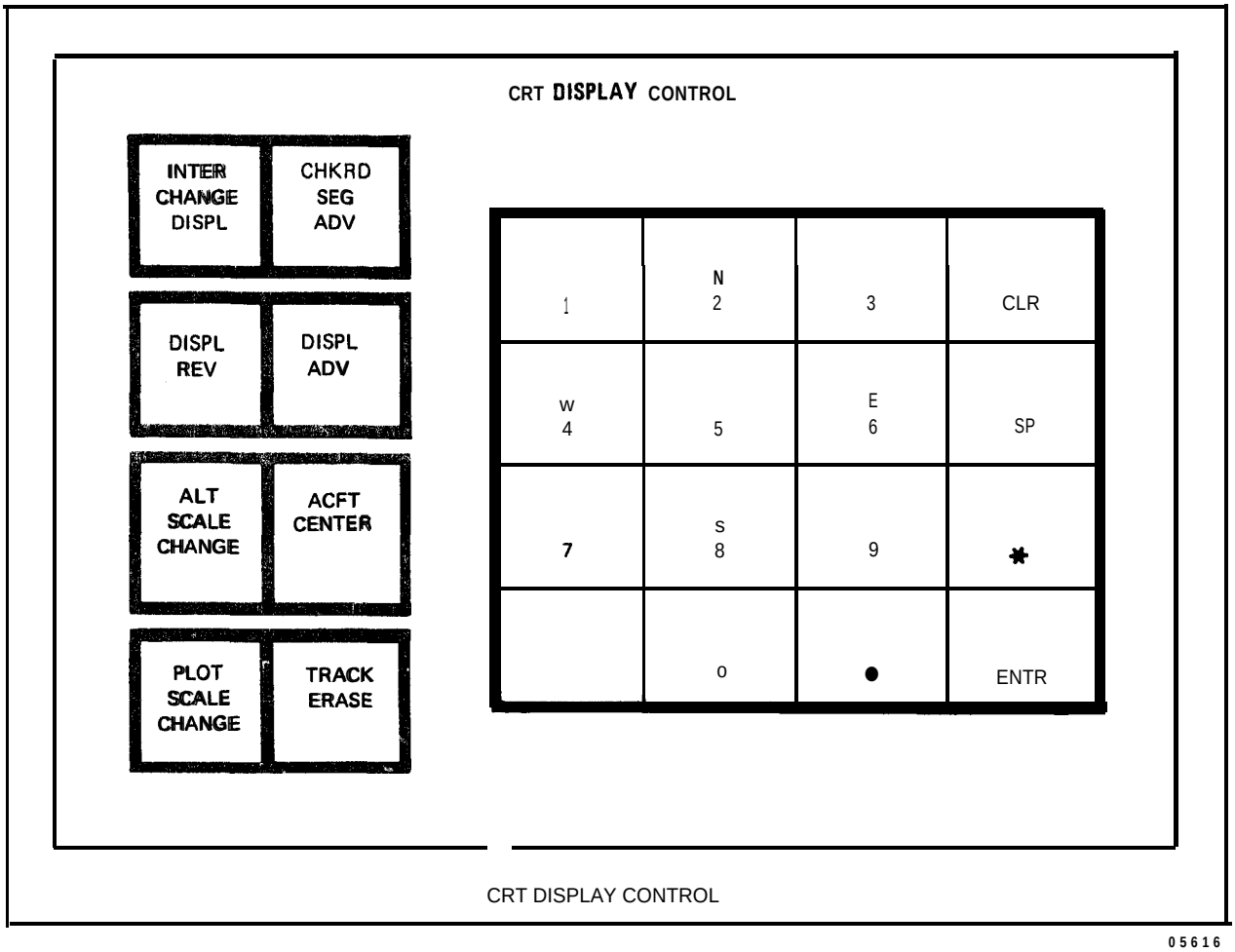
Figure 7-22. Problem Control, Timer, and **IC/MAP/MALF/DEMO/CHKRD** Panel (Sheet 1)

Nomenclature	Function
STORE PLOT switchlight	When activated, stores in computer an instantaneous snapshot of current CRT display for future transfer to hardcopy. Active from either cockpit in any mode. Up to 20 snapshots can be stored before hardcopy printout needs to be made.
CRASH OVERRIDE switchlight	When activated, bypasses crash equations so that simulator will not enter a CRASH FREEZE. Second depression allows the impending crash to place the FWS in a freeze condition. Switchlight blinks when crash occurs. In integrated mode, CRASH OVERRIDE switchlight at gunner IOS functions only as an indicator light.
MALF CLEAR/INH switchlight	Clears all active malfunctions from simulator. If malfunction number is currently selected on thumbwheel, that malfunction continues to be displayed above space allotted to active malfunctions on CRT. In integrated mode, MASTER MALF CLR/INH switchlight at gunner IOS functions only as an indicator light. During checkride exercise, activation of this switchlight inhibits all preprogrammed malfunctions until switchlight is again depressed. Upper area of CRT where active malfunctions are displayed is then cleared. Not functional in checkride mode.
FREEZE switchlight	When activated, freezes FWS during a problem to allow briefings, explanations, or instructions. Second depression releases freeze and starts FWS where it was before freeze. In integrated mode, FREEZE switch can be activated at either pilot or gunner IOS. If FREEZE is initiated by either gunner instructor/operator or crew, for whatever reason, only the pilot instructor/operator or crew can release freeze. If GUNNER CONT switchlight is selected (illuminated) on pilot IOS, and FREEZE is initiated by gunner, anyone in either pilot or gunner compartments can release freeze.
RESET switchlight	Resets digital timer indication to 00:00 in upper right corner area on CRT display.

Figure 7-22. Problem Control, Timer, and IC/MAP/MALF/DEMO/CHKRD Panel (Sheet 2)

Nomenclature	Function
STOP **switchlight**	Stops digital timer count indication on CRT display.
START **switchlight**	Resumes or starts digital timer indication on CRT display.
	NOTE These three **switchlights** above have no control over digital time-of-day clock or elapsed timer mounted on top of left **IOS** console.
DELETE **switchlight**	Any malfunction, **checkride,** or demonstration currently selected on **thumbwheel** is deleted when this **switchlight** is depressed. In integrated mode, DELETE **switchlight** at gunner **IOS** is not operational.
	WARNING Alert pilot and gunner to clear all controls prior to initialization. Abrupt movement of controls by the computer may cause injury.
INSERT **switchlight**	Inserts **checkride,** initial condition, area map, malfunction, or demonstration, depending on number selected on **thumbwheel.** In integrated mode, INSERT **switchlight** at gunner **IOS** inserts only CRT display page selections.
NO. SEL (000-999) **3-digit thumbwheel**	Selects one of 1,000 unique numbers available for insertion or deletion of initial conditions, map displays, malfunctions, demonstrations, or **checkrides.** When a malfunction number is selected, that malfunction is displayed **in** upper area of CRT directly above space allocated to active malfunctions. In integrated mode, this **thumbwheel** at gunner **IOS** can only be used to select CRT display pages. No inputs to training program can be initiated by gunner instructor/operator.

Figure 7-22. Problem Control, Timer, and **IC/MAP/MALF/DEMO/CHKRD** Panel (Sheet 3)



Nomenclature	Function
INTER CHANGE DISPL switchlight	Permits instructor to readily switch between two selected CRT pages. Two pages selected must be from different groups. One group can consist of cross-country and approach maps while the other group can consist of data pages, GCA, or weapon scoring displays. This switchlight uses the most recent selection in each group. In checkride mode, two CRT displays are programmed to appear as appropriate. One display is always the leg display. Second display can be map, weapon scoring, or GCA display. Instructor can override automatic graphic display by selecting specific graphic display.

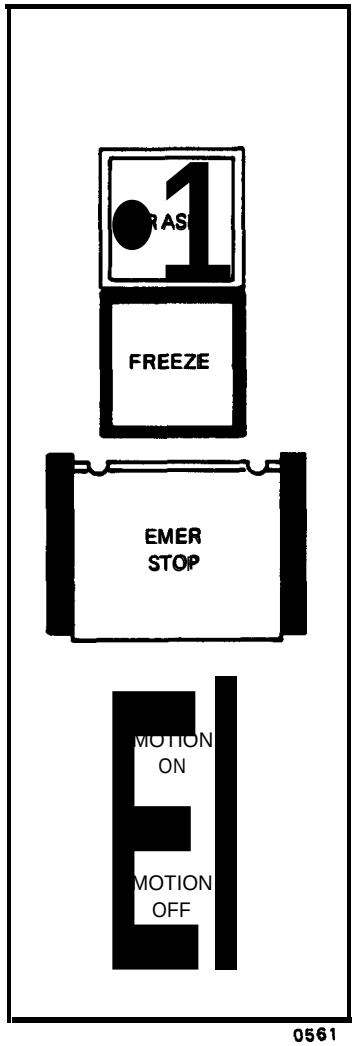
Figure 7-23. CRT Display Control Panel (Sheet 1)

Nomenclature	Function
CHKRD SEG ADV switchlight	Advances CRT leg display and criteria for computer performance evaluation to next checkride segment regardless of trainer status or crew performance. In integrated mode, CHKRD SEG ADV switchlight at gunner IOS functions only as an indicator light.
DISPL REV switchlight	Permits instructor to easily step backwards through multiple page CRT displays such as malfunctions or nav/comm facilities. Communication scenario and clearance-in-effect portion of a particular checkride leg display may require more than one page.
DISPL ADV switchlight	Permits instructor to easily step forward through multiple page CRT displays such as malfunctions or nav/comm facilities. Communication scenario and clearance-in-effect portion of a particular checkride leg display may require more than one page.
ALT SCALE CHANGE switchlight	Alternately changes altitude scale on CRT display from 0 to 2,000 feet to 0 to 4,000 feet and back. When scale change is initiated, any existing flight track on plot changes to represent the same track at new scale.
ACFT CENTER switchlight	Redraws area maps and track history centered around current aircraft position. When cross-country map or approach map is being displayed, depressing this momentary switchlight causes displayed map area to be shifted and centered around current aircraft position.
PLOT SCALE CHANGE switchlight	Changes scale of area map and GCA displays and scale of aircraft/target situation on CRT page 61 (figure 7-13). Approach maps change between 32 x 32, 16 x 16, and 8 x 8 nautical mile scales. Cross-country maps change between 128 x 128, 64 x 64, and 32 x 32 nautical mile scales. GCA alternates between 10 and 2.5 nautical mile scales. The same geographic center is retained at all scales. For the aircraft/target situation, the gunnery field-of-view scale can be switched between 50, 100, 200, or 400 milliradians. A decrease in scale factor increases the represented target size on CRT page only.

Figure 7-23. CRT Display Control Panel (Sheet 2)

Nomenclature	Function
TRACK ERASE switchlight	Temporarily erases (at 1/4 inch/second) aircraft track history, from oldest to newest on CRT ground track plot. When altitude scale is changed or map is recalled, entire track reappears unless data clear has been depressed.
Alphanumeric keyboard	These 16 keyswitches are used in selection of tabular displays on CRT and in modifying of parameter values on CRT pages. Keys labeled N, E, S, and W permit instructor to designate North or South for latitude and East or West for longitude. The dash key is used to input a negative value when changing CRT pages; the period specifies incremental data; and the asterisk is used to select options. In integrated mode, keyboard at gunner instructor station can select all CRT pages, but cannot edit.

Figure 7-23. CRT Display Control Panel (Sheet 3)



Nomenclature	Function
CRASH indicator	When flashing, indicates to crew that FWS has crashed and/or is in crash override.
FREEZE switchlight	When depressed, freezes the FWS during a problem. Second depression releases freeze and starts the FWS at the same point where it was when FREEZE was initiated. If gunner initiates freeze, only pilot instructor/ operator or pilot can release the freeze. However, if GUNNER CONT switchlight is selected on pilot IOS and FREEZE is initiated by gunner, then anyone in either pilot or gunner compartments can release freeze.

Figure 7-24. Pilot/Gunner Control Panel (Sheet 1)

Nomenclature	Function
EMER STOP **switchlight**	When depressed, turns off all **power** to FWS. This **switchlight** is guarded with black barriers and a spring-loaded clear cover to prevent inadvertent actuation. **Switchlight** is illuminated when power is ON. **All** EMER STOP controls throughout simulator complex are functional at all times (lit red) regardless of simulator mode.
MOTION ON **switchlight**	Activates motion system, provided that interlocks are satisfied. This **switchlight** is lit while motion is on. On **IOS** console, SIM POWER ON must be on for this **switchlight** to operate. Interlock function includes access ramp. After switch activation, boarding ramp rises and clears motion platform before motion becomes operational. Prior to responding to mission flight control **inputs,** motion platform erects to neutral position. Neutral position is a point at which hydraulic cylinder legs are extended approximately halfway. Operation of this **switchlight** is not mode-dependent.
MOTION OFF **switchlight**	Deactivates motion platform. Motion platform returns at a controlled rate to neutral position prior to reaching settled position. This **switchlight** is lit when motion is off. Upon settling of motion system, boarding ramp is lowered and aligns with motion platform. Operation of this **switch-**light is not mode-dependent.

Figure **7-24.** Pilot/Gunner Control Panel (Sheet 2)

Section IV. FWS TRAINING CAPABILITIES

7-10. GENERAL. The flight weapons simulator (FWS) includes supporting hardware and software to enhance user understanding of the training concept, to aid problem control and monitoring, and to provide a history for critique and evaluation of crew performance. This hardware consists of a right IOS console CRT display, available disk memory storage of current training conditions and parameters, and a Versatec printer hardcopy output device. The temporary loss due to equipment malfunction of any part of this supporting hardware does not prevent training capability but does degrade the FWS operating efficiency to some extent.

7-11. PLOT STORE. During training modes, the displayed CRT contents can be stored (referred to as a snapshot) on disk for later recall or hardcopy print on the Versatec printer.

a. A total of 20 such snapshots from either or both cockpits can be made before a print plot is requested. A snapshot is recorded whenever the IOS console STORE PLOT switchlight is depressed. The current number of snapshots is displayed on the CRT.

b. During a checkride, segment data automatically initiates plot store at various points in the checkride. In addition, the instructor may initiate plot store at any time.

c. Snapshots can be cleared by printing them or by editing the parametric/freeze/environment CRT page.

7-12. PRINT PLOT. Either during or at the conclusion of the training exercise, a printout of the stored snapshots can be requested from the printer by depressing PRINT PLOT switchlight.

a. This can be initiated with the FWS either on-line or off-line. If hardcopy prints are needed immediately without interruption, then it may be desireable to switch the FWS off-line for dedicated printout time. During on-line operations when computer background time becomes available, the snapshots in memory are converted and begin to print out automatically. No loss of data will occur should the printout process be interrupted when computer time is required for running the training exercise (foreground time). When background time again becomes available, the printout will resume. Should defects show up in the completed hardcopy printout, the snapshots can be printed over again since the data remains held in memory as long as no additional STORE PLOTS have been initiated. When a printout is completed, memory storage of snapshots is erased when the next STORE PLOT command is initiated.

b. Either instructor/operator can initiate a PRINT PLOT command regardless of the operating mode. It should be noted that when PRINT PLOT is initiated, no additional snapshots can be taken until the printout is done. However, if it becomes necessary to obtain a particular snapshot, then depressing the PRINT PLOT button again (to a non-illuminated state) will halt the printing and a snapshot can then be taken. The plots printed out and the one currently interrupted will not be erased from memory if additional STORE PLOTS are initiated. They are added on, providing the total number stored does not exceed 20.

7-13. CRT MAP DISPLAY. Progress of the FWS within the simulated geographical areas is plotted relative to radio navigation facilities in either a game-centered

or aircraft-centered plot mode. One cross-country and ten approach backgrounds are available for map centered displays. These area maps are referenced on the INDEX page as CRT pages 30 through 40. (Figures 7-25 and 7-26 are typical cross-country and approach maps.)

a. During a demonstration or a checkride, map selection is automatic; i.e., called up by the computer based on data stored in memory. During a demonstration, the map is displayed as it was selected, scaled, and centered during the formulation of the demonstration. Similarly, during a checkride, the cross-country or approach is displayed for the appropriate map center. The instructor/operator also has the option to depress ACFT CENTER and rescale the map display manually.

b. During training mode operation, map selection is left to the discretion of the instructor/operator.. Maps are selected by dialing the appropriate map number from 030 to 040 on the three-digit thumbwheel selector and then depressing the INSERT switchlight or by typing the appropriate number on the keyboard and then typing ENTER.

c. The cross-country plot is scaled 128 by 128 nautical miles (rim) with 2- and 4-power expansion capabilities. Approach plots are scaled 32 by 32 nm with 2- and 4-power expansion capabilities; Elapsed time history marks are automatically inserted along the ground track once each 5 minutes. Out-of-tolerance alerts are drawn adjacent to the track as required. The instructor/operator can temporarily erase previous history to unclutter the CRT.

7-14. GROUND-CONTROLLED APPROACH DISPLAY. The CRT display of the ground-controlled approach (GCA) map is shown in figure 7-27.

a. The GCA display can be called up by either selecting 045 on the thumbwheel selector and then depressing the INSERT switchlight or typing 45, ENTER on the keyboard. Azimuth and glidepath-stylized plots are presented when altitude is less than 4500 feet above ground level, the range less than 10 nautical miles, and within a given number of degrees of the approach course.

b. A maximum of five text lines of precision approach radar (PAR) commands can be displayed in the area below the glidepath plot and left of the azimuth plot. If any line contains no information that is useful to the current program, the line is blanked and the lower lines move up. PAR commands consist of the following:

(1) Line 1, variable message consists of short statements concerning the progress of the aircraft in the PAR mode. The message is displayed for 30 to 60 seconds; then line 1 is blank. Variable messages may consist of:

Approaching glidepath
Begin descent
At decision height
Over approach lights
Over landing threshold
Execute missed approach

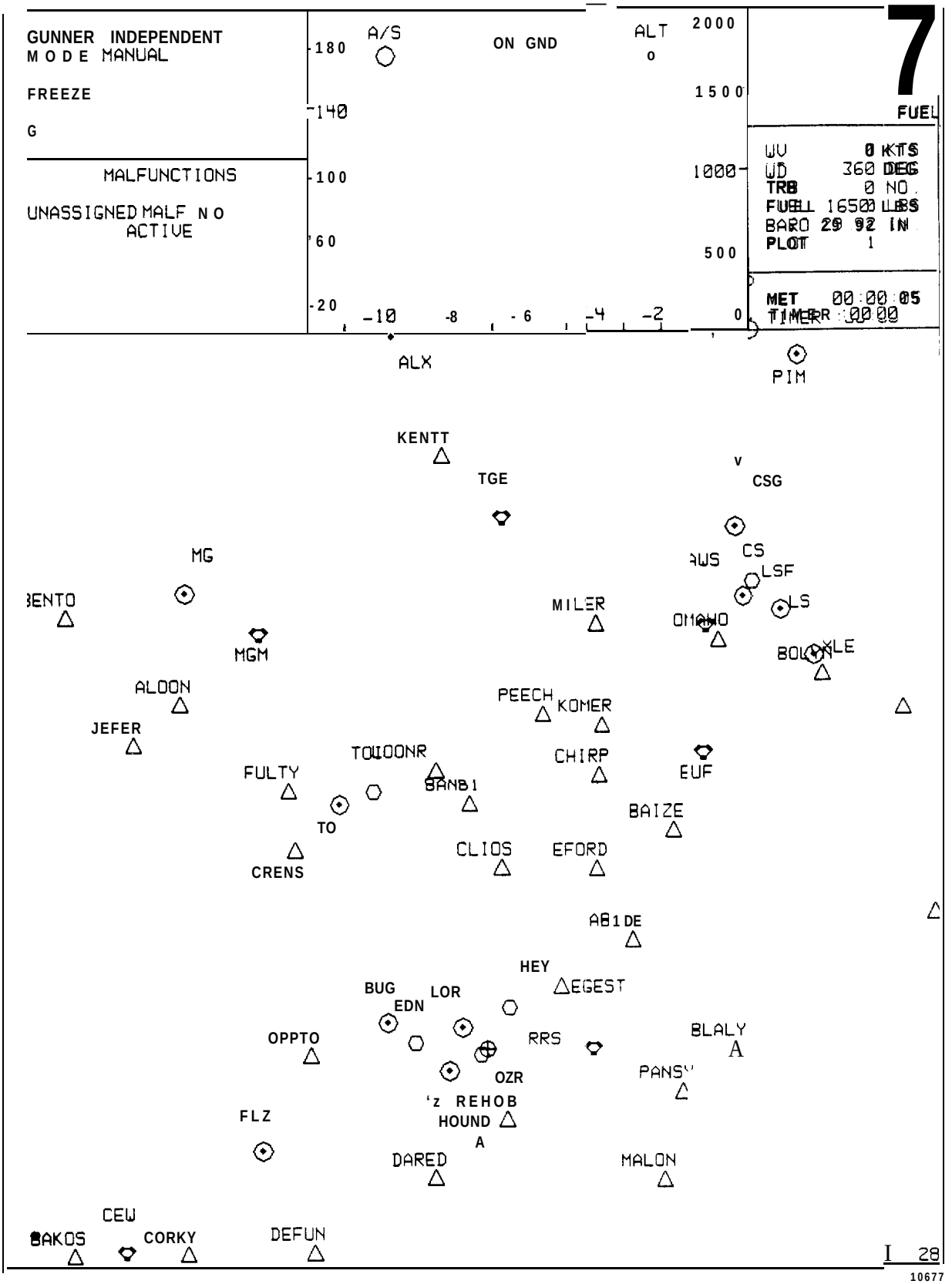


Figure 7-25. Cross-Country Map Page 030

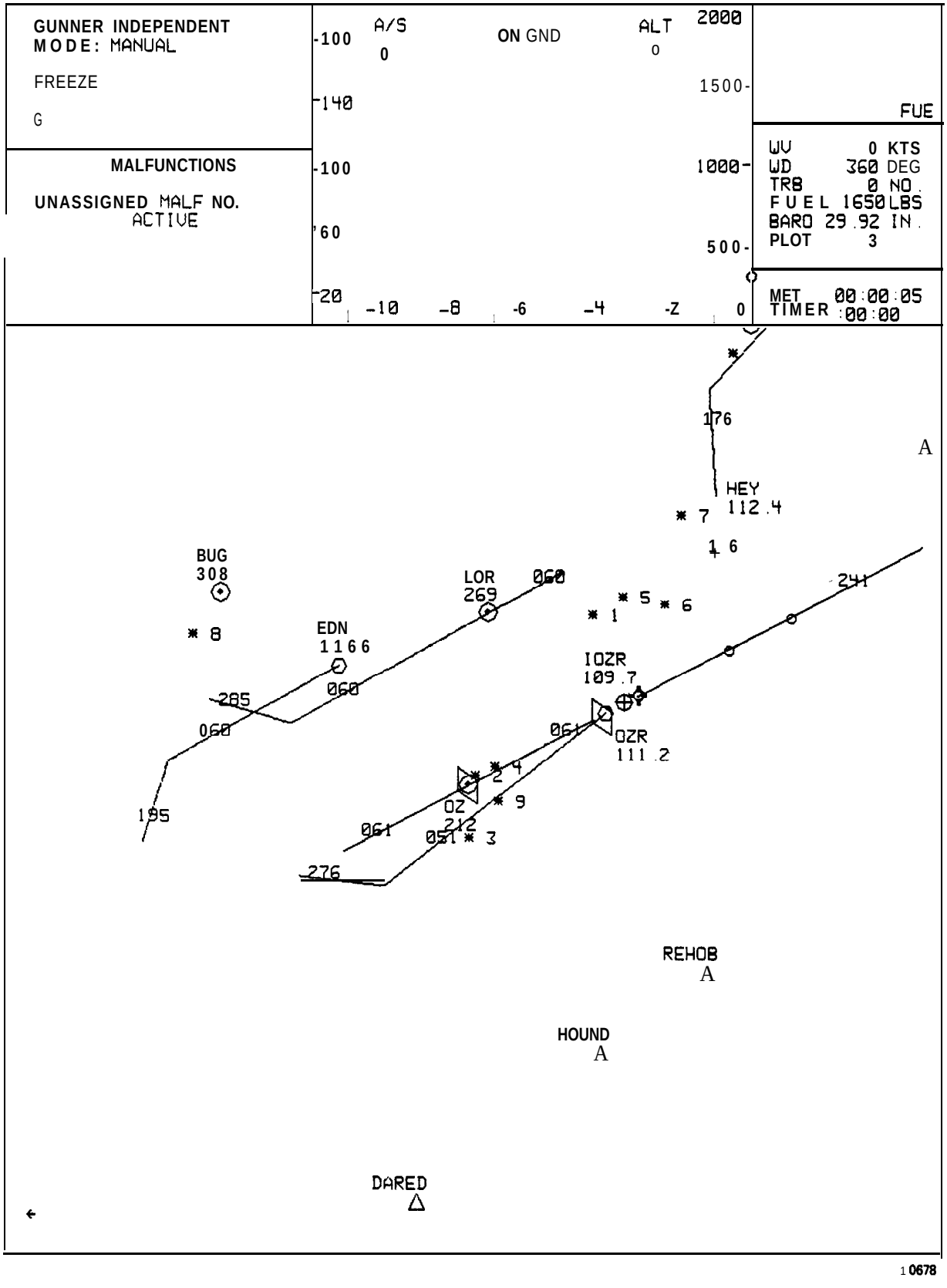


Figure 7-26. Cairns Approach Map Page 032

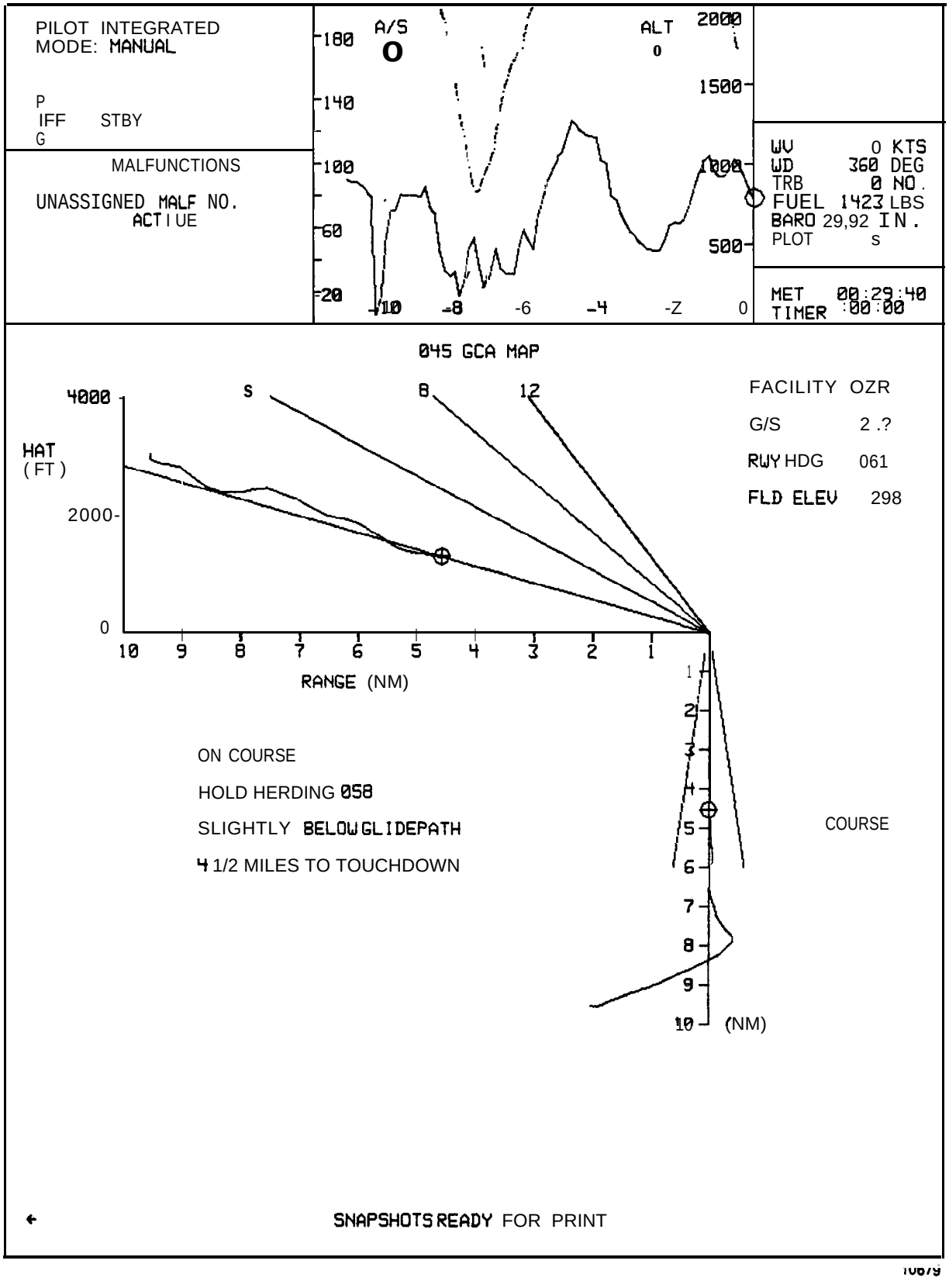


Figure 7-27. Ground-Controlled Approach Page 045

(2) Line 2, course information message may consist of:

On course - error less than 0.5°
Slightly left/right of course - error less than 1.5°
Well left/right of course - error greater than 1.5°

(3) Line 3, glidepath information message may consist of:

On glidepath – error less than 0.28°
Slightly above/below glidepath - error less than 0.42°
Well above/below glidepath - error greater than 0.42°

(4) Line 4, touchdown distance information message indicates distance in nautical miles to touchdown. The number is expressed as a mixed number with a fractional readout update in 1/4-mile increments.

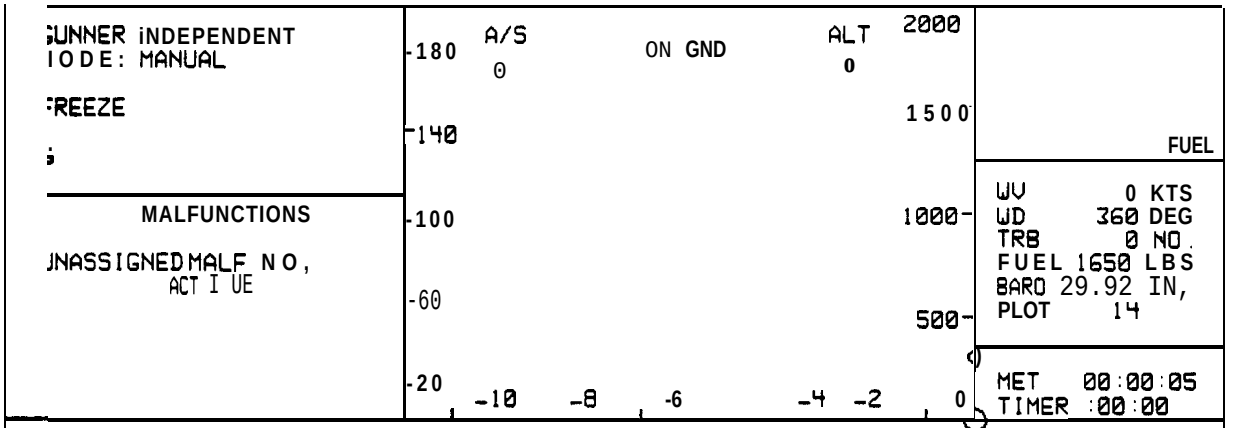
(5) Line 5, turn to heading information message consists of steering commands that vector the aircraft either on course during surveillance mode or steering commands to stay on course during the PAR mode.

c. Switching to GCA display 045 too early during approach or pattern vectoring may cause disorientation to airfield other than destination selected. It is recommended that aircraft symbol be vectored to within 10 NM of desired destination airfield, within 10 degrees of final approach course centerline, and aircraft heading within 15 degrees of final approach course heading before switching to GCA page 045.

7-15. RADAR EMITTER THREATS AND WEAPON CONTROL. The instructor/operator has available editable CRT pages to effect hostile target selection, radar emitter threats to the aircraft, and assignment of the weapon loading configuration.

a. Threat array CRT page 025 (figure 7-28) and threat window array page 026 (figure 7-29) provide the instructor/operator with 10 different ground radar emitter threats to the aircraft. These CRT pages describe the type, activity level, location, and the directional scanning area for each emitter site. The degree of activity can be edited for either manual or automatic mode and applies to the three closest sites relative to the position of the aircraft. Line 11 on CRT page 025 is not editable, and serves only as information as to the mode of operation. The manual or auto mode is selectable on CRT page 050, line 08 or page 61, line 6. For the automatic mode, when radar emitter contact with the aircraft is made, the degree of activity advances automatically and, after certain time delays, shoots down the helicopter unless evasive maneuvers are performed by the crew. Manual mode allows the instructor/operator full control for advancing or delaying the degree of activity. The system power status line item on page 025 indicates the status of the APR-39 radar signal detector set. The APR-39, when turned on, provides a visual and audible warning to the pilot that an emitter threat has made contact with the aircraft.

b. Threat numbers 1, 2, and 3, of the 10 EW emitters are colocated with storable targets 1, 13; and 25, respectively (figure 7-30). Threat numbers 4 and 5 are within the boundaries of the modelboard, but not colocated with storable targets. The remaining 5 threats (6 through 10) are situated off the modelboard within the boundaries of the instrument gaming area. The threat emitter-defined parameters on CRT pages 025 and 026 are editable. However, editing may result in confusion for both the instructor/operator and the student, since the latitude, longitude,



025
THREAT ARRAY

	TYPE 1	ACTIVE 2	LAT 3	LONG 4	ELEV 5
01	ZSU	S1	N031 19'15"	W085 44'18"	155
02	SA-8		N031 13'57"	W085 48'56"	200
03	ZSU		N031 11'38"	W085 49'09"	114
04	ZSU		N031 14'22"	W085 48'09"	109
05	SA-8	S1	N031 19'54"	W085 43'07"	171
06	SA-8		N031 19'23"	W085 41'26"	210
07	SA-6		N031 22'47"	W085 40'46"	161
08	SA-4		N031 18'24"	W086 00'15"	190
09	FLAP		N031 13'03"	W085 48'00"	105
10	SA-4		N031 28'06"	W085 38'44"	1+0

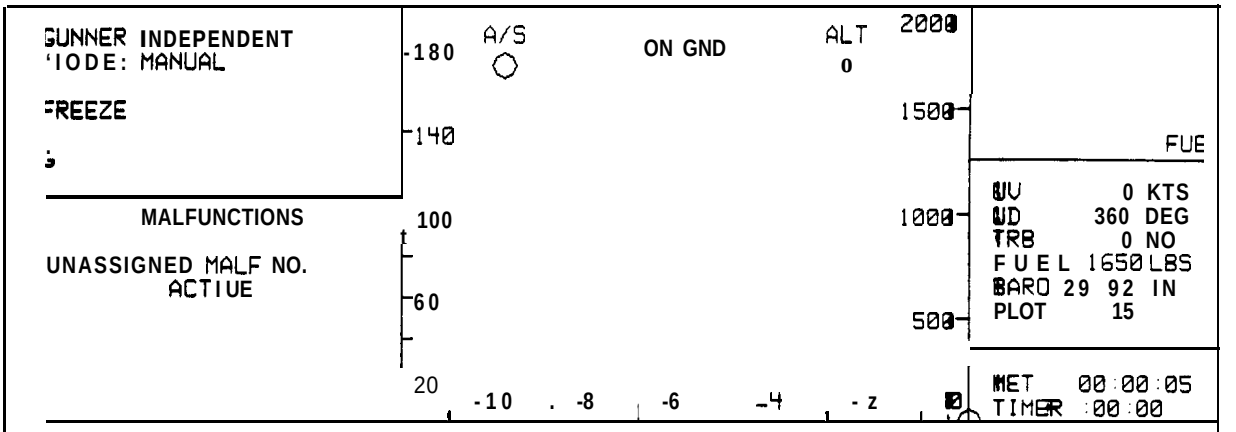
11 MODE MNL (0-MANUAL,1-AUTO)

PWR SYS ON

TYPES OF THREATS
1 - ZSU23-4
2 - SA-4
3 - SA-6
4 - SA-8
5 - FLAPWHEEL

DEGREE OF ACTIVITY
S1 - SEARCH
A2 - ACQUISITION
T3 - TRACK
M4 - MISSLE ACTIVE

Figure 7-28. Threat Array Page 025



026
THRT WNDW ARRAY

	TYPE	WNDW-1 AZ		WNDW-1 EL		WNDW-2 AZ		WNDW-2 EL	
	1	2	3	4	5	6	7	8	9
01	ZSU	275	285	0	15	150	175	5	20
02	SA-8	300	355	-4	20	020	280	-5	20
03	ZSU	270	359	5	20	015	040	0	12
04	ZSU	025	035	5	15	120	180	0	15
05	SA-8	190	210	2	20	055	062	-15	20
06	SA-8	180	200	5	20	215	230	-10	10
07	SA-6	225	270	-10	15	170	190	5	15
00	SA-4	100	140	-10	10	030	048	-10	10
09	FLAP	359	025	-20	10	200	210	-20	10
10	SA-4	200	209	-5	10	165	200	-10	10

10681

Figure 7-29. Threat Window Array Page 026

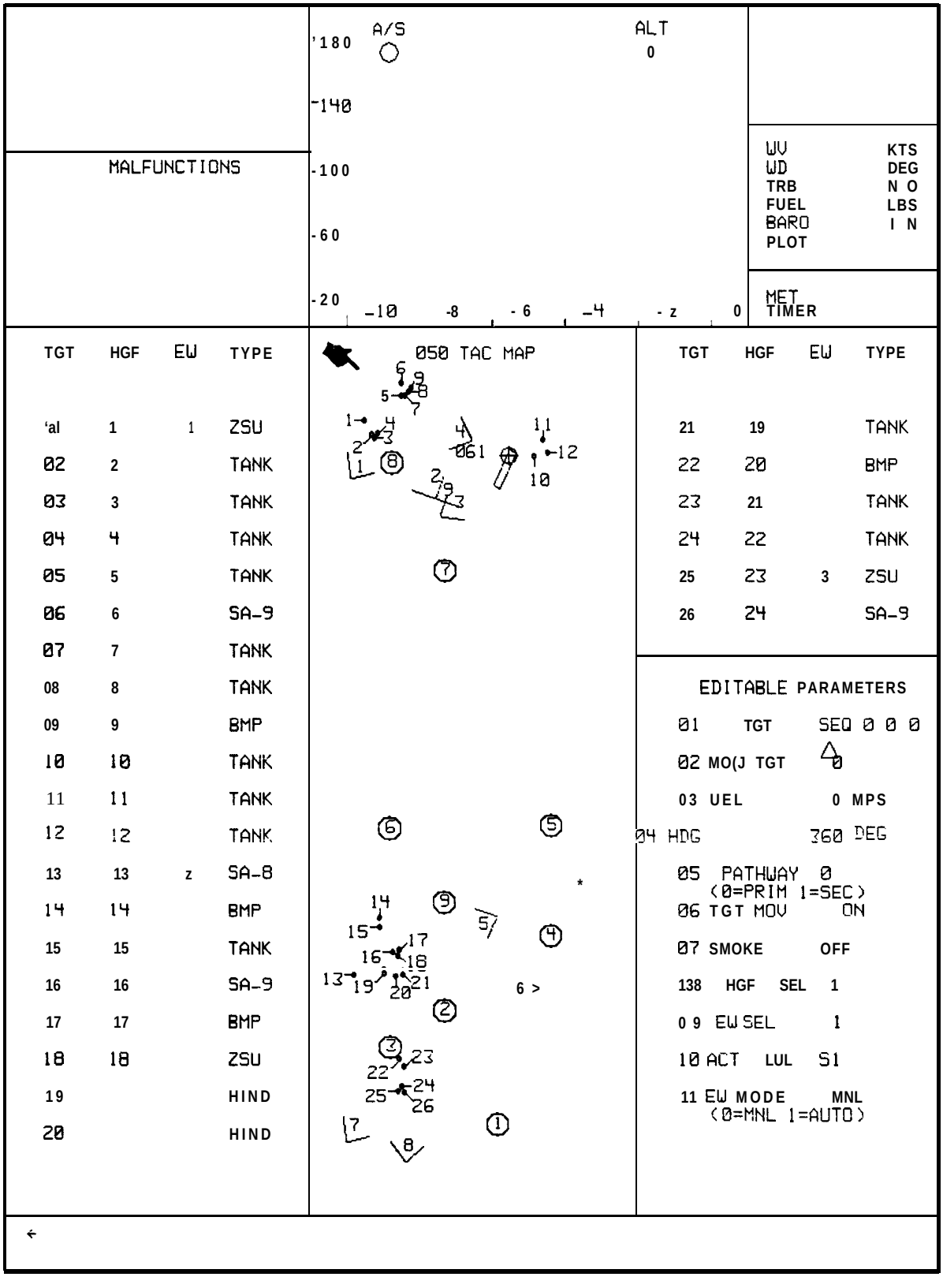


Figure 7-30. Tactical Map Page 050

elevation, and window parameters must be directly related to and correspond with the actual terrain of the model board. This also applies to the emitter window parameters. Ideally, when it is desired to set up new threat array location(s), editing may be performed at the CRT, and when all new parameters are realistic and compatible, a software change can be made off-line. Editing on CRT page 025 and 026 is accomplished by entering line number, column number, space, new parameter, enter. For example, to change SW threat number 01 activity level to acquisition (manual mode), perform the following functions on the alphanumeric keyboard; 1, 2, SPACE, 2, ENTER.

c. Ground targets are provided in the visual scene in the form of military vehicles, buildings, etc., and weapon targets. Up to three targets in sequence can be selected by the instructor, with one as a moving target to be displayed on the telescopic sight unit (TSU). For scoring purposes, the selected target on the TSU is always considered broadside and perpendicular to the line-of-sight of the aircraft. Tracers impacting or overlaying the target are scored as a hit. Tracers not overlaying or impacting the target are scored as a miss.

d. The target of interest (storable target) is selected by activation of the target advance switchlight. This action causes the target designator symbol (W) to advance to the next available target in the sequencing line (see figure 7-13 and figure 7-31). This can be accomplished on CRT page 050 or CRT page 061. Three scoring bugs (one for each weapon system) are depicted on CRT page 061. When threat is advanced, scaling information is transposed to Student History page 062.

e. wWeapon loading is selected by the instructor/operator on the configuration display CRT page 060 (figure 7-12). Ten different weapon loading configurations are available. The current status of the weapons mission control and remaining armament at each aircraft weapon station is presented on the performance display CRT page 061 (figure 7-13). At the lower central portion of the CRT page is a listing of the selected weapons configuration including the number of rounds remaining. Also included at the bottom of the page are several editable lines for target sequence, weapon configuration, and lasar parameter selection.

7-16. COMMUNICATIONS FACILITY DATA. Communications facility data is displayed whenever a map is selected for one of the approach plots.

a. Approach map facility data consists of field elevation, departure and approach control frequencies, tower frequencies, and ground control frequencies. All communications facility data is shown on the appropriate map displays.

b. When operating in checkride, the CRT displays the instructor-provided communications scenario for each checkride segment or leg. The DISPL ADV switchlight allows the instructor/operator to inspect upcoming scenarios, and the DISPL REV switchlight allows the instructor to inspect past scenario pages on a page-by-page basis each time the appropriate switchlight is depressed. When a checkride segment advance occurs, the appropriate page for that segment is automatically displayed. All communications scenario messages are shown with appropriate checkride parameter information on the CRT page display.

7-17. NAVIGATION FACILITY DATA. Seven groups of navigation facilities are available, one group of which is not specified (FM). The groups and the related CRT display page numbers are as follows:

(910)	**LF/ADF**
(920)	VOR
(930)	GCA
(940)	**ILS-LOC**
(950)	**ILS-OMB**
(960)	**ILS-MMB**
(970)	FM

a. The facility groups above are identified on their respective CRT pages. A typical page is shown in figure 7-31. From any facility group page other than 970 (FM), sub-pages are accessed on the CRT by typing in the line number and depressing ENTER. A typical sub-page, shown in figure 7-32, provides specific information for the navigation facility selected. Other sub-pages within the group may be accessed by depressing the **DISPL ADV** or **DISPL** REV switches as desired. To leave the navigation facility sub-page to access other CRT pages, first depress ENTER to access the INDEX and then select the desired page.

b. FM facilities are defined on CRT page 970. When called, the first two facilities contain no defined data allowing two FM stations to be located anywhere in the game environment. The third facility is defined and not editable. This station provides homing to the stagefield. No sub-pages exist for these facilities.

7-18. DEMONSTRATION . The simulator has the ability to demonstrate maneuvers and techniques using prerecorded exercises of actual flight maneuvers. This is resident on disk memory along with accompanying audio commentary recorded on cassette magnetic tape. In the independent mode, audio is not available to one cockpit if the other cockpit is already using the same demonstration.

a. The instructor/operator cannot edit the CRT pages. **IOS** switches applicable to motion, visual, communications, and CRT selection remain operational. During the demonstration playback mode of operation, the FWS is under computer control. The commentary remains synchronized (i.e., pauses, when the demonstration is frozen) . There are up to nine maneuver marks per demonstration; these are intermediate points from which a demonstration or portion thereof can be initiated. If demonstration audio is not available a message on the bottom of the **IOS** CRT alerts the instructor/operator. If a demonstration is requested for an intermediate point (maneuver mark), accompanying audio will not be available.

b. When a demonstration is selected, the CRT displays the appropriate page(s) that were programmed during the recording.

c. In independent mode, actuation of the AUTO FLIGHT switchlight at the gunner **IOS** CRT console before selection of a demonstration **or** maneuver, allows the pilot portion of the demonstration to control and fly the gunner cockpit while the gunner trains in his specific tasks.

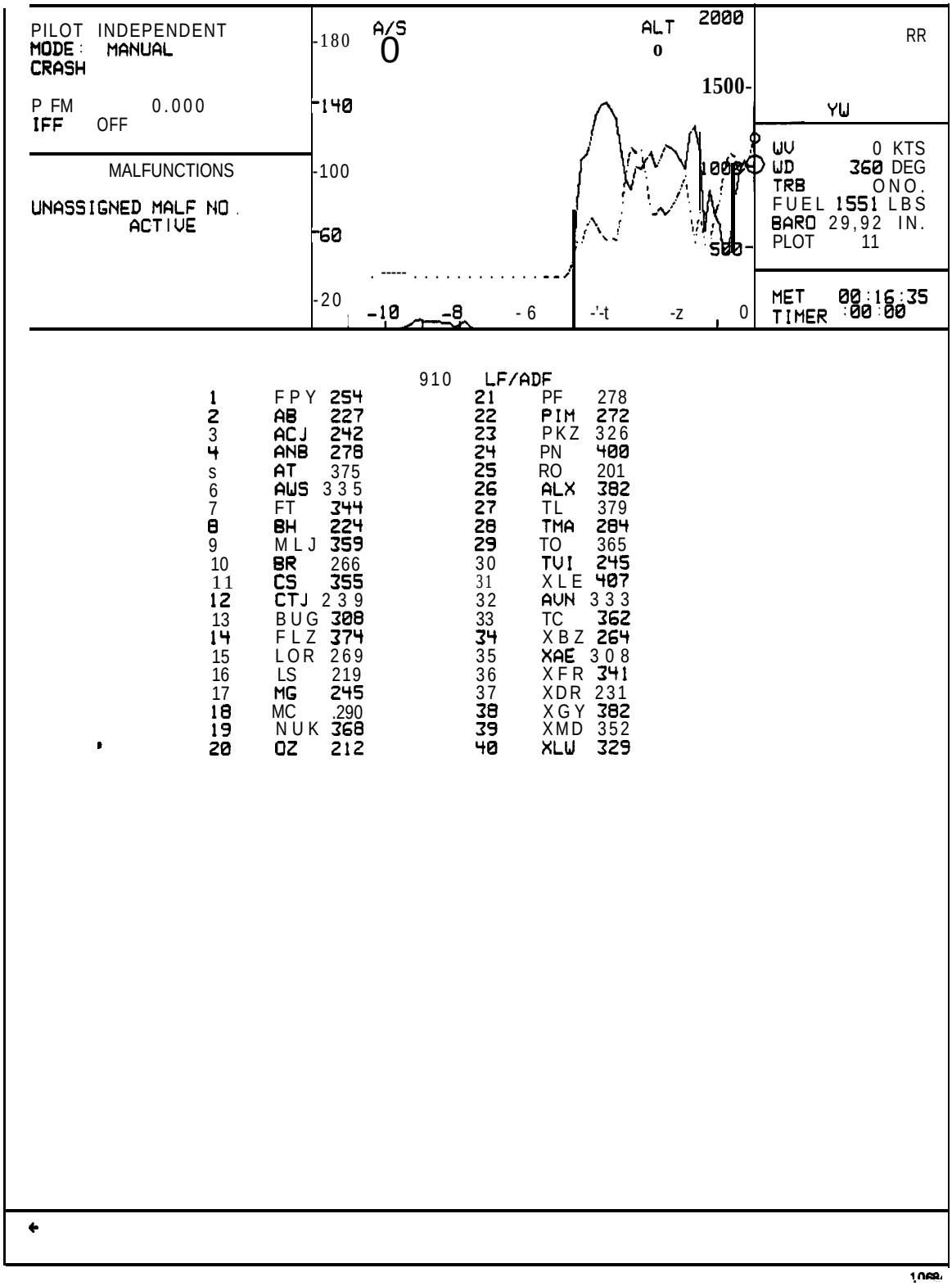


Figure 7-31. Typical Navigation Facility Page

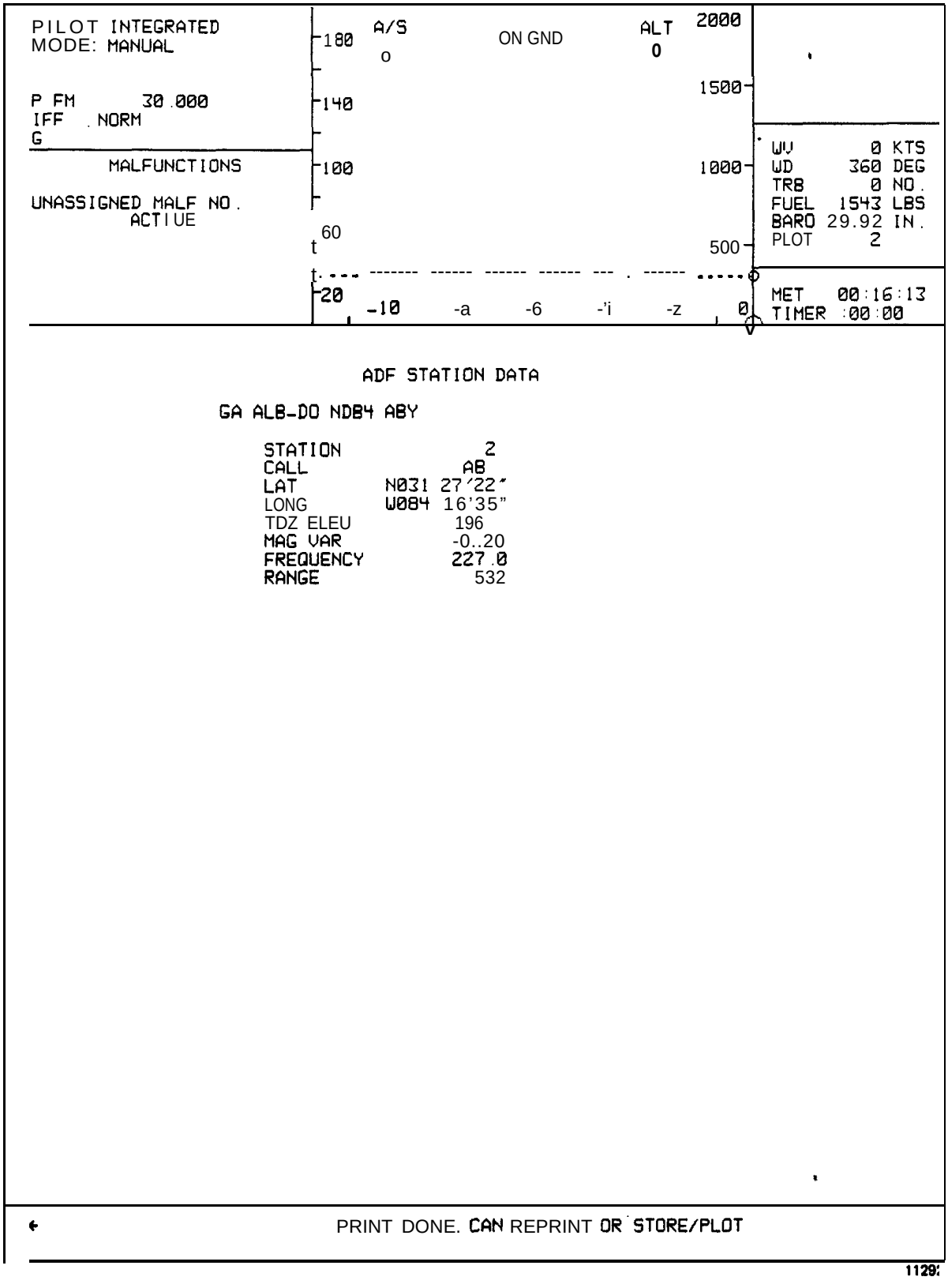


Figure 7-32. Typical Navigation Facility Sub-Page

7-19. PERFORMANCE MONITORED TOLERANCES. Monitored tolerances of crew performance during a checkride are specified for each segment at the time of formulation. The checkride monitor display indicates both desired value and tolerance applied for each segment. Training tolerances are based on values not to exceed (vNE) and are shown in table 7-1. These tolerances may be changed by rewrite of the software program. The VNE monitor is operable in either training or checkride modes. The VNE automatically triggers alert messages that are displayed on the CRT.

7-20. AUTOMATED CHECKRIDE. Tactical checkrides, a visual flight rules (VFR) checkride, and an instrument flight rules (IFR) checkride are available to the pilot in the independent mode or to both the pilot and gunner in the integrated mode. During a checkride, the instructor/operator can perform no editing functions that can vary the difficulty or alter the exercise. The instructor/operator is required to perform certain duties that cannot be performed by the computer. These duties are primarily associated with providing air traffic controller (ATC) communications or necessary crew communications. The instructor can also override and advance schedule segments at any time, regardless of trainer status or trainee performance, by depressing CHKRD SEG ADV switchlight or inhibit malfunctions during exercises by actuating the MASTER MALF CLR/INH switchlight.

a. An automated checkride consists of a series of predetermined maneuvers with associated parameters entered in memory against which a set of predetermined performance standards are specified. Each checkride is segmented into exercises. The instructor can select the whole checkride or any of the exercises. The crew flies the FWS and is evaluated by the computer program to the degree, frequency, and duration of deviation from predefined performance tolerances. When an exercise is selected, automatic monitoring is limited to the parameters defined for the selected exercise. The program prints out error data regarding crew performance of each segment during the checkride. The instructor can use the printout for evaluation and critique of the performance. Hardcopy printout consists of errors detected for each checkride segment along with the mission elapsed time (MET) at the end of the segment monitored. In addition, snapshots (stored plots) of the CRT can be printed out by the Versatec printer which show ground track, airspeed, altitude plots, plus status and time.

b. During a checkride, the segment or leg display is presented automatically. The display contains the communications scenario of ATC messages and briefs, the segment description, performance monitoring data for the leg, and information on the next leg. The segment description contains the numerical designation of the leg and a brief description of the maneuver performed during the leg. The right column of the display is reserved for pertinent remarks and when necessary an expanded description of the leg. Related map, weapon scoring, or GCA displays are preprogrammed as appropriate. This graphic display is available to the instructor/operator by actuation of the INTERCHANGE DISPL switchlight. After a second actuation of this switchlight, the display returns to the leg display. At any time, the instructor/operator can override the automatic advance of the segment display by selecting a specific numerical designation during the checkride. The instructor can step forward or backward through the checkride segments by depressing the DISPL ADV or DISPL REV switchlights.

7-21. CHECKRIDE DISPLAY. During a checkride, the CRT display automatically presents and updates checkride maneuver requirements and the crew performance for each segment. In addition, the CRT presents information, as typically shown in figure 7-33, on accumulation of error for the monitored segment as follows:

Table 7-1. Values Not To Exceed (VNE)

Parameter	VNE low limit	VNE high limit	Crash trigger
Roll	60° left	60° right	Exceeds limits of 25° left or right when skid height is less than 10 ft in altitude
Pitch	2 ball widths left	2 ball widths right	Exceeds limits of 60° nose up or 80° nose down for normal in-flight conditions. Exceeds 13° nose up or 25° nose down when skid height is less than 10 ft in altitude
Yaw	2 ball widths left	2 ball widths right	N/A
Yaw Rate	-80°/sec	+80°/sec	Turn rate exceeds 100°/sec when skid height is less than 10 ft in altitude
Altitude	N/A	14000 feet	N/A
Airspeed	-30 knots	+170 knots	Exceeds limits of -35 knots or 40 knots lateral left or right when skid height is less than 10 ft in altitude. Exceeds 200 knots for normal in-flight conditions
Vertical Velocity	-2000 ft/min	+2000 ft/min	Landing descent of more than -600 ft/min at skid touchdown
Rotor Torque	0%	100%	Exceeds limit of 120%
Rotor RPM (emergency)	91%	105%	Rotor rpm limits of greater than 109% or less than 53% under normal flight conditions
Rotor RPM (automatic)	97%	101%	
Fuel	160 lbs	1750 lbs	N/A
G Load	N/A	N/A	Greater than 3.5 at pull out of dive condition

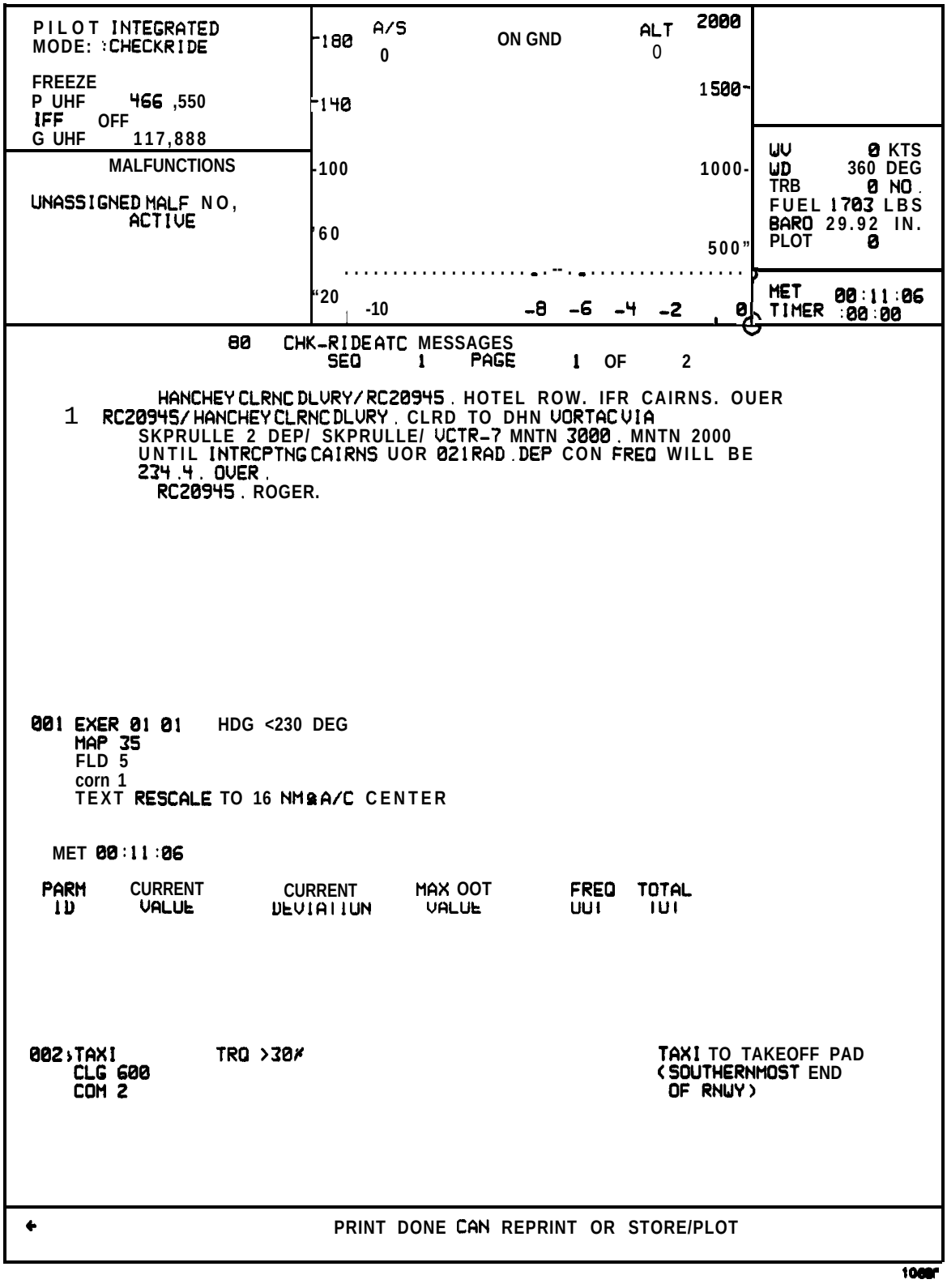


Figure 7-33. Typical **Checkride** CRT Display

a. Lines 1 through 6, when all applicable, **display** maneuver number, maneuver description, segment end conditions, and parameter values and tolerances that the monitor program **checks.**

b. Line 7 displays MET.

c. Lines 8 and 9 consist of header titles describing monitored parameters formatted:

PARAM ID	CURRENT VALUE	CURRENT DEV	MAX OOT VALUE	FREQ OOT	TOTAL TOT

7-22. CREW PERFORMANCE ERROR PRINT SYSTEM. Crew performance errors are printed on the Versatec printer in the computer **room whenever the** ERROR PRINT SYS ON **switch-**light at the left IOS console is illuminated, printer is turned on, and chemicals and paper loaded. Pilot information is printed to the left and gunner information to the right in independent **mode. Both are printed to the left in integrated** mode. Figure **7-34 is representative of a typical error printout summary page. During a checkride, the** checkride **monitor data is printed at segment end. During training or checkride operations, the system prints a log of gross pilot error (VNE) and the time of occurrence. The printout also indicates when any VNE returns to within the normal envelope of allowed limits.**

7-23. INTERCOMMUNICATIONS SYSTEM (ICS)**. Private communications between instructors, computer** room, and observer is provided via an ICS network.

7-24. ENVIRONMENTAL CONDITIONS. During a normal training mode of operation (not **checkride** or demo) , the outside air temperature (OAT) , barometric pressure, wind, day/dusk or night visual condition, turbulence level, visibility range, ceiling, and cloud thickness can be changed by editing the current conditions pages 020 or 021 on the CRT. Using the keyboard, the appropriate line is edited by typing the line number, space, the new value, and then ENTER. Parameters such as lighting, seat shaker, and APU are controlled by inputting numerical values of 1 for ON and O for OFF.

7-25. PARAMETER FREEZE. Aircraft flight parameters can be selectively frozen at the IOS by editing lines 1 and 3 through 11 on the current conditions CRT page 020. Frozen parameters are flagged by an asterisk symbol (*). To freeze a **parameter,** use keyboard to type the line number, space, * (asterisk symbol) , ENTER. To unfreeze a parameter, use keyboard to type the line number, space, ENTER.

7-26. SOUND LEVELS. The environmental aircraft sound level, edited using number O through 9, can be **changed by editing the current** conditions CRT page 020. This requires using the keyboard to input the line number, space, **(0-9),** ENTER.

7-27. **FREEZE/CRASH OVERRIDE. The** instructor/operators **and crew have the capability to place the simulator in a freeze condition if a problem arises or to allow time for explanation or instruction. A CRASH OVERRIDE** switchlight**, available only to the instructor/operator,** bypasses computer command so that the simulator does not enter a crash freeze condition should performance exceed established limits. Motion cueing is not available in crash override.

a. All action of the FWS can be frozen at any instant by depressing the FREEZE switchlight at either of the IOS or crew control panels. The FREEZE switchlight

```
00:07:23   IFR   046                    A/S
00:07:37   IFR   046                    A/S                  TR
00:07:56   IFR   046                                         TR
00:08:15   IFR   050

053 DESCENT        ROT   720PS     IAS   100+-10K          CONTINUE DESCENT
                                   ALT > 1900'             START INBOUND TURN
                                   ROD   500+-100FPM

MET   00:09:10   MANUAL ADVANCE
PARM     CURRENT          CURRENT      MAX OOT              FREQ    TOTAL
 ID       VALUE          DEVIATION      VALUE               OOT     TOT
IAS       95:37
ALT      1875.0             25.0       1870.0               1       3
ROD       450.5

057 LEVEL TURN   HDG   249+-1DEG    IAS    100+-10K   CONTINUE TURN
                                    ALT > 1600        START NDB APPROACH
                                    ROT    3+-1DPS    START DESCENT TO 160

MET   00:11:05
PARM   CURRENT           CURRENT      MAX COT      FREQ  TOTAL
  ID    VALUE           DEVIATION      VALUE       OOT    TOT
IAS     95.02
ALT   1650.0
ROT      4.06             0.06         4.06         1      5
00:15:19   IFR   062                          PT
00:20:01   IFR   067

069  LEVEL FLIGHT AOB 10DEC        IAS 100+-10K      START APPROACH. TURN
     ALL          TIME 3SEC       ALT 2000+-100'    OUTBOUND FROM CAIRNS
                                                    OUTER COMPASS LOCATOR

MET  00:21:32   MANUAL ADVANCE
```

05625

Figure 7-34. Typical Error Printout Summary Page

illuminates steady when the freeze mode is active. The freeze condition can be removed by redepressing the FREEZE switchlight.

b. Unusual conditions of attitude, rotor rpm, airspeed, vertical speed, torque, or combinations of the preceding can trigger a simulator crash. If a crash occurs, the trainer is placed in a crash freeze mode indicated by blinking of CRASH switchlights at the cockpit control panels and the CRASH OVERRIDE switchlight blinking at the IOS. The FREEZE switchlight illuminates steady. Depression of the FREEZE switchlight does not override the crash status. The crash can be eliminated by initialization of an IC set or bypassed by use of the CRASH OVERRIDE switchlight. Depression of the CRASH OVERRIDE switchlight reverts the trainer to a normal freeze status. If the CRASH OVERRIDE switchlight is selected (illuminated steady) during a training exercise and the crew triggers a simulator crash, the only indication will be a blinking CRASH message in the upper left cockpit status area of the CRT display. The instructor/operator can then manually freeze the FWS if desired.

c. If a visual probe crash/fault occurs, the visual system goes into RETRACT mode which inhibits further mechanical movement of the system and presents an in-clouds scene to the FWS. (Refer to PROBE FAULT/CRASH reset switchlight functions in Section III of this Chapter for details.)

7-28. ICING MALFUNCTION. Malfunction numbers 601, 603, and 763 are incorporated under malfunction number 572 and occur simultaneously. Independent selection of these malfunctions (other than 572) will have no effect on instrument indications or flight characteristics.

a. Instructor/operator selects the appropriate icing malfunction number and depresses INSERT.

b. Instructor/operator reduces visibility (using VSBY RANGE control) and monitors VSBY on CRT page 21 to an altitude of 2600 feet or trainer is flown into less than an icing condition.

c. Instructor/operator edits free air temperature on CRT page 20 to less than 4.4°C and/or trainer is flown to an altitude whereby the standard lapse rate reduces indicated temperature to less than 4.4°C.

d. The following are chronological steps and resultants of icing conditions:

(1) After 2 minutes, pitot/static stoppage occurs with airspeed decreasing at a rate of 1 Km/second (unless pitot heat is applied).

(2) After 4 minutes, additional power requirements are necessary to maintain altitude.

(3) After 6 minutes, rotor out-of-balance condition occurs as icing is asymmetrically shed from blades.

e. Deletion of icing malfunction is accomplished as follows:

(1) Select DELETE; observe reverse chronological sequence of onset.

(2) When free air temperature is edited (page 20) to be greater than 4.4°C, observe reverse chronological sequence of onset.

(3) When standard lapse rate increases temperature to a condition greater than **4.4°C,** observe reverse chronological sequence of onset.

Section V. SIMULATED MALFUNCTIONS

7-29. GENERAL . There are 207 simulated malfunctions available for the FWS which are systematically arranged on 11 CRT pages. These pages are used to reference the Malfunction for selection and possible insertion into the training exercise. Any of the 11 CRT pages can be displayed by typing the appropriate page number, ENTER t the IOS keyboard.

a. In the independent mode, neither instructor can insert or delete malfunctions that affect the other cockpit. In the integrated mode, the pilot instructor controls the malfunction for both cockpits and the gunner instructor has no malfunction editing control., For either mode, insertion or deletion of malfunctions while in a freeze condition is not allowed.

b. Malfunctions as presented on the CRT pages that are associated with the pilot only are preceded by the letter P. Those applicable to the gunner only are indicated by the letter G. Malfunctions with no annotation are applicable to both.

c. A total of five malfunctions can be active simultaneously for each cockpit in the independent mode. In the integrated mode, five active malfunctions shared by both cockpits can be active simultaneously. When five are currently active and another malfunction is inserted, the oldest malfunction is automatically deleted and replaced by the new entry.

7-30. MALFUNCTION INSERTION. During checkrides, the selected preprogrammed malfunctions are automatically displayed when active. In the training mode, malfunctions can be inserted at the IOS control panel.

a. The thumbwheel is used to insert the applicable line number for the desired Malfunction. A descriptive title of the malfunction and its number appear above and to the left in the malfunctions status area of the CRT display.

b. Depressing the INSERT switchlight above the thumbwheel inserts the malfunction into the system, and the description of the malfunction inserted appears in he malfunctions status area.

7-31. MALFUNCTION DELETION. Active malfunctions can be deleted at any time, except during freeze or when operating in the checkride mode, by either of the two following methods:

a. All active malfunctions can be deleted simultaneously by depression of the MALF/CLR/INH switchlight at the IOS control panel.

b. Selective deletion of active malfunctions can be made using thumbwheel selector as follows:

(1) The thumbwheel selector is set to the applicable line number for the malfunction to be deleted. Descriptive title of the selected malfunctions and their associated numbers appear above and to the left in the malfunction status of the CRT display.

(2) Depressing the DELETE switchlight deletes the active malfunction from the system and from the malfunctions status area of the CRT display. Active malfunction descriptions that are listed below the deleted description in the status area are moved up on the active malfunction list.

7-32. CLEARING MALFUNCTIONS. All malfunctions can be cleared by deletion except the ones that trip circuit breakers (CB). Circuit breakers must be manually reset after the malfunction has been deleted. When a CB malfunction is active, the circuit breaker cannot be manually reset. Actuation of the MALF/CLR/INH switchlight at the IOS control panel during an exercise clears all preprogrammed malfunctions until the switchlight is depressed again.

7-33. MALFUNCTION LIST. Table 7-2 lists the CRT line select number and descriptive title of the available malfunctions. Primarily the malfunctions are grouped by system in numerical order and shown as they are displayed on the CRT. The malfunction details in table 7-3 include the method of introduction, indications and effects on related systems, effects sensed by student prior to corrective action, and any corrective action that is required.

NOTE

Malfunction numbers 601, 603, and 763 are incorporated under malfunction number 572, and occur simultaneously. Independent selection of these malfunctions (other than 572) will have no effect on instrument indications or flight characteristics. Refer to paragraph 7-28 for a narrative of icing malfunctions.

NOTE

Malfunctions number 803 through 806 are not available. Independent selection of these malfunctions will have no effect on weapon systems.

Table 7-2. Malfunction List

350 Avionics Systems

351	P AI
352	G AI
353	GYRO COMP INOP
354	COMP SLV INOP
355	P UHF XCVR
356	G VHF/FM XCVR
357	P VHF/AM XCVR
358	P **LF-ADF**
359	P **VOR/ILS/MB**
360	G DPLR RTA
361	G DPLR SDC
362	P **AN/APX100** KIT
363	P **AN/APX100** ANT
364	P **AN/APX100** ALT
365	P ADI GS INOP
366	P ADI FLIGHT DIR
367	P CRS OVERSEN
368	P HSI GS INOP
369	P HSI NAV
370	P HSI RNG DISPLAY
371	P HSI BRG PTR #1
372	P **HSI** BRG PTR #2
373	P HSI HDG PRECE

400 Circuit Breakers

AC/ARM Panel

401	ADF **RCVR-AC**
402	ATTD IND **PLT-AC**
403	GYRO **CMPS-AC**
404	RADIO **BLWR-AC**
405	SEL **PWR-AC**
406	PWR FACTOR **CORR-AC**
407	REF **XFMR-AC**
408	28 VAC **XFMR-AC**
409	ENG VIB METER-AC
410	SCAS **PWR-AC**
411	ADS PWR-DC
412	ADS ANTI ICE-AC
413	FUEL **QTY-AC**
414	TMS **PWR-AC**
415	TURRET **PWR-AC**
416	HSS **PWR-AC**
417	LRF **PWR-DC**
418	TMS **BLWR-DC**
419	TURRET DRIVE-DC
420	TURRET GUN-DC
421	TURRET STOW-DC
422	**ALT PWR-AC**
423	ALT **PWR-DC**
424	HUD **PWR-DC**
425	HUD **BLWR-AC**

Table 7-2. Malfunction List - Continued

400 Circuit Breakers - continued

DC Panel

426 G ATTD **IND-DC**
427 FM **XCVR-DC**
428 VOICE **SCTY-DC**
429 UHF XCVR-DC
430 ADF **RCVR-DC**
431 VOR **ILS-DC**
432 VOR **ILS-AC**
433 **ICS PLT-DC**
434 ICS GNR-DC
435 IFF **XPDR-DC**
436 DPLR **NAV-DC**
437 UHF **XCVR-DC**
438 RADAR **ALTM-DC**

439 GEN FIELD-DC
440 GEN BUS RESET-DC
441 Dc **VM-DC**
442 P **HTR-DC**
443 SRCH LT **CONTR-DC**
444 ANTI COLL **LT-DC**
445 POS **LT-DC**
446 **TRU-AC**
447 **INV-DC**
448 SRCH LT **PWR-DC**
449 CAUT **LT-DC**
450 P INST **LT-DC**
451 G INST **LT-DC**
452 CKPT **LT-DC**
453 START **RLY-DC**

454 IGN SOL-DC
455 GOV **CNTR-DC**
456 IDLE STOP SOL-DC
457 ENG DEICE-DC
458 FIRE **DETR-DC**
459 TEMP IND ENG **XMN-DC**
460 TGT **IND-DC**
461 GAS PROD-DC
462 DUAL **TACH-DC**
463 ECS **CONTR-DC**

464 EMER HYD **PMP-DC**
465 HYD **CONTR-DC**

466 SCAS **PWR-DC**
467 FORCE TRIM-DC
468 TURN/SLIP **IND-DC**
469 **ALTM-DC**
470 RPM WARN-DC
471 TRQ **IND-DC**
472 FUEL/OIL VALVE-DC
473 FUEL BOOST **FWD-DC**
474 FUEL BOOST AFT-DC

475 **IR** JAM CONTR-DC
476 **IR** JAM **PWR-DC**
477 RADAR WARN-

480 Electrical System

481 P CMPLT ELEC FAIL

482 P DC GEN

483 FAULTY RELAY

484 P A/C INVERTER

485 P ALTERNATOR FAIL

486 P INSTR LIGHTS
487 G INSTR LIGHTS

488 P TRU FAI

Table 7-2. Malfunction List - Continued

500 Engine Instruments

501 P N1 TACH
502 G N1 TACH
503 ROTOR TACH
504 N2 TACH

505 P TRQMTR
506 G TRQMTR

507 P ENG OIL PRESS LOW
508 P ENG OIL PRESS IND
509 P ENG OIL TEMP IND

510 P TURBINE GAS TEM

550 Engine Systems

551 P HOT START
552 P HUNG START
553 FLAMEOUT
554 COMPR STALL
555 FUEL CTL RPM GAIN
556 FUEL CTL RPM LOSS
557 ENG OIL LOSS
558 ENG STARTER
559 P INL GD VANE OPEN
560 P INL GD VANE CLSE
561 ENG FUEL PMP
562 OIL BYPASS
563 ENG INL OBST
564 BLD BAND STUCK OPEN
565 BLD BAND STUCK CLSD
566 GOV SW HIGH SIDE
567 GOV SW LOW SIDE
568 ENG FIRE
569 P FIRE LIGHT
570 ENG CHIPS
571 ENG CHIPS LIGHT
572 ICI

600 Flight Instruments

601 PITOT/STAT STOPAGE
“602 P TRN NDL

603 ADS, ICI

Table 7-2. Malfunction List - Continued

650 Flight Control Hydraulic System

651 #1 HYD SYS
652 #2 HYD SYS
653 BOTH HYD SYS

654 P HDOVR SCAS-PITCH
655 P HDOVR SCAS-ROLL
656 P HDOVR SCAS-YAW

657 P MOTOR SCAS-PITCH
658 P MOTOR SCAS-ROLL
659 P MOTOR SCAS-YAW

660 P TOTAL SCA

700 Fuel System

701 P FUEL QTY IND ZERO
702 P FUEL QTY IND STCK

703 P FWD BST PMP
704 P AFT BST PMP

705 P CNTMTD FUEL FLTR

706 FUEL LOW LIGHT

707 P FUEL OVRCNSMP

Table 7-2. Malfunction List- Continued

750 Rotor/Transmission

751	MN RTR TRCK
752	MN RTR BAL
753	TL RTR HI FRQ VIBR
754	LOSS OF TL RTR
755	TL RTR FIXED PITCH
756	P XMN OIL-PRES HIGH
757	P XMN OIL-TMP HIGH
758	XMN OIL PRES LOSS
759	XMN OIL BYPASS
760	SHORT SHAFT
761	90 DEG GR BOX LOSS
762	TL RTR THRUST LOSS
763	RTR ICE
764	XMN CHIPS MALF
765	XMN CHIPS LIG

800 Weapons Systems

801	20 MN FAIL/FIRE
802	20 MN RUNAWAY
803	7.62 FAIL/FIRE(LT)
804	7.62 FAIL/FIRE(RT)
805	7.62 RUNAWAY(LT)
806	7.62 RUNAWAY(RT)
807	JAMMED GUN TURRET
808	TOW FAIL/FIRE
809	TOW HANG FIRE
810	2.75 FAIL/FIRE(LO)
811	2.75 FAIL/FIRE(LI)
812	2.75 FAIL/FIRE(RI)
813	2.75 FAIL/FIRE (RO)
814	2.75 HANG FIRE(LT)
815	2.75 HANG FIRE(RT)
816	FCC FAIL
817	HUD FAIL
818	ALT FAIL
819	LRF FAIL
820	RMS FAIL
821	LASER FAIL
822	P AN/APR39 IND
823	PARTIAL HUD FAIL
824	G TOW BIT-MCA FAIL
825	G TOW BIT-EPS FAIL
826	G TOW BIT-SCA FAIL
827	G TOW BIT-TSU FAIL
828	P HSS BIT FAIL
829	G HSS BIT FAIL
830	P HSS RETICLE FAIL
831	G HSS RETICLE FAIL
832	HSS BIT-EIA FAI

Table 7-3. Simulated Malfunction Details

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student (s) if corrective action is not taken	Required corrective act ion	Indications presented to instructor/OperatOr and student
			350 AVIONICS SYSTEMS MALFUNCTIONS		
P AI	#351	Pilot attitude indicator frozen at last position.	N/A	Check CB in.	Instructor: P AI appears on CRT. Student: Attitude indications remain unchanged or will be erroneous as aircraft moves in pitch and roll.
G AI	#352	Gunner attitude indicator frozen at last position.	N/A	Check CB in.	Instructor: G AI appears on CRT . Student: Attitude indications remain unchanged or will be erroneous as aircraft moves in pitch and roll.
GYRO COMP INOP	#353	Pilot gyrosyn compass frozen at last heading.	N / A	Check CB in.	Instructor: GYRO CMP INOP appears on CAT. Student: Heading card does not move with changes in aircraft heading.
COUP SLV INOP	#354	Gunner RNI frozen at last heading.	N/A	Check CB in.	Instructor: COMP SLV INOP appears on CRT. Student: Heading card does not move with changes in aircraft heading.
P UHF XCVR	#355	No UHF signal reception or transmit.	N/A	Check CB in.	Instructor: P UHF XCVR appears on CRT. Student: Transceiver not operative.
G VHF/FM XCVR	#356	No VHF/FM signal reception or transmit.	N/A	Check CB in.	Instructor: G VHF/FM XCVR appears on CAT. Student: Transceiver not operative.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			350 AVIONICS SYSTEMS MALFUNCTIONS - continued		
p VHF/AM XCVR	#357	No VHF/AM signal reception or transmit.	N/A	Check CB in.	Instructor: p VHF/AM XCVR appears on CRT. Student: Transceiver not operative.
p LF-ADF	#358	No identification or bearing information.	N/A	Check CB in.	Instructor: p LF-ADF appears on CRT. Student: No reception.
P VOR/ILS/MB	#359	No glideslope, bearing, or localizer information.	N/A	Check CB in.	Instructor: P VOR/ILS/MB appears on CRT. Student: No reception.
G DPLR RTA	#360	Doppler navigation set alphanumeric display indicator error.	MEM panel light illuminates. TEST MODE MAL panel light illuminates.	Check CB in. Initiate TEST MODE on the Doppler nav panel. Switch off SET for manual navigation of aircraft	Instructor: G DPLR RTA appears on CRT. Student: Erroneous velocity, position and steering information is presented.
G DPLR SDC	#361	Doppler navigation set alphanumeric display indicator error.	MEM panel light illuminates. TEST MODE MAL panel light illuminates.	Check CB in. Initiate test mode on the Doppler nav panel. Switch off SET for manual navigation of aircraft.	Instructor: G DPLR RTA appears on CRT. Student: Erroneous velocity, position and steering information is presented.
p AN/APX 100 KIT	#362	NO-GO and KIT indicators illuminate while MODE 4 switch is set to TEST. Transponder not able to identify aircraft due to external computer malfunction.	N/A	None	Instructor: p AN/APX 100 KIT appears on CRT. Student: Transponder panel status indicator shows fault.
p AN/APX 100 ANT	#363	NO-GO and ANT indicators illuminate when any mode switch is set to test. Transponder not able to identify aircraft due to problem with antenna.	N/A	None	Instructor: P AN/APX 100 ANT appears on CRT Student: Transponder panel status indicator shows fault.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indicat ions presented to instructor/operator and student
		350 AVIONICS SYSTEMS MALFUNCTIONS - continued			
P AN/APX 100 ALT	#364	NO-GO and ALT indicators illuminate indicating failure is due to attitude digitizer.	N/A	None	Instructor: P AN/APX 100 ALT appears on CRT. Student: Transponder panel status indicator shows fault.
p ADI GS INOP	#365	On attitude direction indicator instrument, slope indicator remains centered and GS (glide slope) flag comes into view.	N/A		Instructor: P ADI GS INOP appears on CRT. Student: ADI does not reflect aircraft slope movements.
p ADI FLIGHT DIR	#366	On attitude direction indicator instrument, horizontal steering bar remains centered but FD (flight director) flag is out of view.	N/A	None	Instructor: p ADI FLIGHT DIR appears on CRT. Student: ADI horizontal steering bar does not reflect aircraft movements.
p CRS OVERSEN	#367	Horizontal situation indicator course deviation bar sensitivity is increased by a factor of four. Similarly, attitude direction indicator horizontal steering bar is oversensitive by a factor of four.	N/A	No	Instructor: p CRS OVERSEN appears on CRT. Student: HSI and ADI indications are difficult to center with aircraft under control.
p HSI GS INOP	#368	On horizontal situation indicator, glide slope deviation pointer remains centered and GS flag comes into view.	N/A		Instructor: P HSI GS appears on CRT. Student: HSI glide slope pointer does not reflect aircraft movements.
p HSI NAV	#369	On horizontal situation indicator course deviation bar remains centered but NAV (navigation) warning flag is out of view.	N/A		Instructor: p HSI NAV appears on CRT. Student: Course deviation bar does not reflect aircraft movements.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
		350 AVIONICS SYSTEMS MALFUNCTIONS - continued			
P HSI RNG DISPLAY	#370	On horizontal situation indicator, RANGE indication does not function.	N/A	None	Instructor: P HSI RNG DISPLAY appears on the CRT. Student: RANGE indication does not change in response to aircraft movement.
P HSI BRG PTR #1	#371	On horizontal situation indicator, bearing pointer number 1 gives erroneous indication of selected ground station location.	N/A	At HSI control panel select BRG PTR 2, if available.	Instructor: P HSI BRG PTR #1 appears on the CRT. Student: Not able to select and rely on bearing pointer number 1 indication.
P HSI BRG PTR #2	#372	On horizontal situation indicator, bearing pointer number 2 gives erroneous indication of selected ground station location.	N/A	At HSI control panel select BRG PTR 1, if available.	Instructor: P HSI BRG PTR #2 appears on the CRT. Student: Not able to select and rely on bearing pointer number 2 indication.
P HSI HDG PRECE	#373	On horizontal situation indicator, heading pointer precesses (gyrates) at approximately 10° per minute. No other effects are noted.	None	None	Instructor: P HSI HDG PRECE appears on the CRT. Student: HSI course pointer does not have a steady indication.
		400 CB'S AC/ARM and DC PANELS MALFUNCTIONS			
Selected individual popping circuit breakers. All are AC or DC push-pull, non-toggle type.	#401 through 477	Any number of CB's indicated on CRT page 400 can be popped under instructor control. The indications are the physically popped breaker, and simulation of interrupted electrical power to the associated equipment. All correct power-off characteristics are exhibited.	Popped CB(s) and power-off characteristics for the associated equipment.	Attempt to reset CB, which may, or may not, be resettable depending upon instructor discretion.	Instructor: Applicable title of the popped CB appears on the CRT. Student: Popped breaker and associated power-off characteristics for the associated equipment.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			480 ELECTRICAL SYSTEMS MALFUNCTIONS		
P CMPLT ELEC FAIL	#481	All electrical components including lights and instruments cease to function.	All electrical systems are inoperative.	Land as soon as possible. Check position of ELEC PWR EMERG OFF switch on gunner MISCELLANEOUS control panel.	Instructor: CMPLT ELECT FAIL appears on CRT. Student: All instruments, lights, and other electrically driven components cease to function.
P DC GEN	#482	DC GEN caution lights illuminate. Other indications depend on operating mode and crew station control switching. The 3 distribution busses (ESS, NONESS, ARMAMENT) can be powered from the transformer/rectifier unit (TRU) bus which is powered by the alternator. Additional sources of powering ESS bus are the battery or externally from the ground power unit.	DC GEN caution lights in both cockpits illuminate. No equipment will lack power if the alternator is available to power the TRU. If the alternator is unavailable, the essential bus and ac bus can be powered by the battery, and all nonessential bus loads will be available. Voltmeter reads battery voltage, ammeter reads 0.	Check the GEN switch on pilot PWR panel is not off. Switch down to reset and then turn back on. Check GEN BUS RESET and GEN FIELD CB's. If not restored, switch the GEN SW to off and the GEN FIELD CB to open.	Instructor: P DC GEN appears on CRT. Student: DC GEN caution lights illuminate in both cockpits.
FAULTY RELAY	#483	ALTER and RECT caution lights illuminated intermittently. With alternator selected, ac source relay intermittently cycles ac loads to and from the inverter and alternator. (When relay is de-energized, ac source is the inverter and ALTER and RECT lights illuminate; when relay is energized, ALT and RECT lights extinguish indicating the alternator is the source.)	ALTER and RECT caution lights illuminate intermittently. Total effect is dependent on operating mode and cockpit switching.	Assure that a dc source input to the inverter is selected as a backup as soon as possible when the alternator is switched out by the faulty relay.	Instructor: Malfunction title appears on CRT. Student: ALTER and RECT caution lights illuminate intermittently.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
		480 ELECTRICAL SYSTEMS MALFUNCTIONS - continued			
P A/C INVERTER	#484	If the alternator is off, all ac power will be lost regardless of dc generator, external power, and battery status. Equipment loss (with associated power-off indications; e.g., SCAS NO-GO lights) will be the following: TRU FUEL QTY ENG VIB MTR SCAS PWR ATTD IND PLT REF XXFMR 28 VAC XFMR GYRO CMPS RADIO BLWR TURRET PWR SSS PWR SECU PWR TMS PWR ADS ANTI ICE ALT POWER HUD BLWR PWR FACTOR CORR ADF RCVR VOR/ILS	Loss of ac powered equipment if the alternator is off.	Check INV CB. If in, select alternator if available.	Instructor: Malfunction title appears on CRT. Student: Loss of ac operated equipment if alternator is not available; otherwise no impact, except that no backup source of ac power is available.
ALTERNATOR FAIL	#485	ALTER and RECT caution lights illuminate, indicating that the alternator is not supplying power. Power to all busses is still available if the dc generator is operating and the inverter is operating (depending on operating mode and crew station switching). If the dc generator is not available, the essential bus can be powered by the battery.	ALTER and RECT caution lights illuminate. Other effects depend on operating mode and crew station control switching, and could range from loss of all electrically operated equipment, to loss of none.	ALTN switch to OFF, then RESET, then turn back ON.	Instructor: Malfunction title appears on CRT. Student: ALTER and RECT caution lights illuminate. If the alternator is selected as the sole source of electrical power, all electrically operated equipment will fail until an alternate source (dc generator, battery, external power) is selected.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			480 ELECTRICAL SYSTEMS MALFUNCTIONS - continued		
P INSTR LIGHTS	#486	Pilots instrument panel illumination is interrupted.	Loss of illumination of all instrument panel lights.	Check all pilot INST LTS CB.	Instructor: PLT PNL LTS appears on CRT. Student: Loss of all instrument panel illumination.
G INSTR LIGHTS	#487	Gunners instrument panel illumination is interrupted.	Loss of illumination of all instrument panel lights.	Check all gunners INST LTS CB.	Instructor: GNR PNL LTS appears on CRT. Student: Loss of all instrument panel illumination.
TRU FAI	#488	The RECT caution lights illuminate and dc busses can not receive power from the alternator.	RECT caution light illuminates and dc power is lost if dc generator is off and battery or ext power is not available. DC power can be selected from an alternate source by proper cockpit switching.	Check TRU circuit breaker. Select dc generator if available and not previously selected.	Instructor: Malfunction title appears on CRT. Student: RECT caution lights on. Other indications dependent on cockpit switching, range from loss of all dc power to loss on no dc power.
			500 ENGINE INSTRUMENT MALFUNCTIONS		
P N1 TACH G N1 TACH	#501 #502	Failure of mechanical linkage between engine and instrument. No effect on system operation.	Gas generator tachometer returns to zero.	Check indications that engine is still operating (N_2, torque and exhaust gas temperature indicators, engine sound).	Instructor: N_1 TACH appears on CRT. Student: Gas generator tachometer needle goes to zero, or stays at zero in engine-start.
ROTOR TACH	#503	Failure of mechanical linkage between rotor and instrument. No effect on system operation.	Rotor tachometer returns to zero. RPM warning system activates.	Check indications that engine is still operating (N_1 engine tachometer, torque and exhaust gas temperature indicators, engine sound).	Instructor: ROTOR TACH appears on CRT. Student: Rotor tachometer needle goes to zero.
N2 TACH	#504	Failure of mechanical linkage between engine and instrument. No effect on system operation.	Rotor tachometer returns to zero. RPM warning system activates.	Check indications that engine is still operating (N_1 rotor tachometer torque and turbine gas temperature indicators, engine sound).	Instructor: N_2 TACH appears on CRT. Student: Engine tachometer needle goes to zero.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			500 ENGINE INSTRUMENT MALFUNCTIONS - continued		
P TRQMTR G TRQMTR	#505 #506	Torquemeter returns to zero. No effect on aircraft or systems operation.	Torquemeter goes to zero psi.	Check TRQ IND CB. Check indications that engine power is available. If in integrated mode, check with gunner.	Instructor: Words TRQMTR appears on CRT. Student: Torquemeter indication goes to zero.
P ENG OIL PRESS LOW	#507	Due to bad pressure transducer, instrument reading decreases to 70 PSI during normal engine operation. No effect on aircraft or systems operation.	Engine oil pressure indicator will not rise above 70 PSI.	Check ENGINE OIL PRESS light not illuminated. Check other engine indications. Land as soon as possible.	Instructor: ENG OIL PRESS IND appears on CRT. Student: Engine oil pressure indicator decreases to zero.
P ENG OIL	#508	Instrument reading decreases to zero. No other effect on aircraft or system operation.	Engine oil pressure indicator goes to zero.	Check ENGINE OIL PRESS light not illuminated. Check ENG/XMSN TEMP IND CB. Check other engine indications.	Instructor: ENG OIL PRESS IND PRESS IND appears on CRT. Student: Engine oil pressure indicator decreases to zero.
P ENG OIL TEMP IND	#509	Engine oil temperatue indication high. No effect on aircraft or system operation.	Oil temperature indicator goes from present reading to 120°C at a rate of 15°C/30 second.	Ensure ENG OIL BYP switch is OFF. Accomplish normal landing at nearest safe landing area.	Instructor: ENG OIL PRESS IND appears on CRT. Student: Engine oil temperature indicator increases to 120°C at a rate of 15°C/30 seconds.
P TURBINE GAS TEM	#510	Instrument reading decreases to zero. No other effect on aircraft or system operations.	Engine TGT indicator goes to zero.	Check TGT IND CB. Check all other engine parameters for normal response.	Instructor: TGT IND appears on CRT. Student: TGT instrument decreases to zero and does not respond to any change in engine control and/or electrical interruption. (CB cycling.)

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			550 ENGINE SY STEMS MALFUNCTIONS		
FLAMEOUT	#553	Flameout indications are: Sudden reduction of engine noise. A sudden drop in engine rpm, gas producer rpm, rotor rpm, oil pressure, and torquemeter indications. A left yaw resulting from the reduction in engine torque. Total lack of engine response to throttle movements. Gradual decrease in TGT, engine oil temperature and transmission oil pressure.	Flameout indications are: Sudden reduction of engine noise. A sudden drop in engine rpm, gas producer rpm, rotor rpm, oil pressure, and torquemeter indications. A left yaw resulting from the reduction in engine torque. Total lack of engine response to throttle movements. Gradual decrease in TGT, engine oil temperature, transmission oil temperature, and transmission oil pressure.	Enter autorotation. If altitude permits, attempt air start.	Instructor: FLAMEOUT appears on CRT. Student: Engine shutdown indications and left yaw resulting from loss of torque.
p HOT START	#551	Normal gas producer speed for start is evident, but TGT exceeds starting temperature limit.	TGT rises beyond normal safe operating range.	Abort start as follows: Close throttle. Fuel switch - OFF. Starter - Continue to energize until TGT decreases. Complete engine shutdown.	Instructor: HOT START appears on CRT. Student: TGT exceeds starting temperature limit.
p HUNG START	#552	Gas producer rpm fails to accelerate beyond 20%.	Gas producer rpm maintains a value of approximately 20% while TGT is within the normal operating range.	Close throttle. Shut off fuel. Motor engine to clear fuel vapor.	Instructor : HUNG START appears on CRT. Student: Gas producer rpm fails to exceed 20%. No engine runup indications.
COMPR STALL	#554	Fluctuation in gas producer rpm occurs accompanied by a fast TGT rise. Engine rpm remains normal. Increase in engine noise is evident. NOTE This condition occurs during high power settings.	TGT increases beyond normal operating limits. Engine noise continues to increase.	Reduce power. Rain removal/ECU-switch - OFF. If stall progresses, enter autorotation.	Instructor: COMPR STALL appears on CRT. Student: Gas producer indications fluctuate; TGT rises rapidly above safe operating limit and popping noise heard from engine compartment.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			550 ENGINE SYSTEMS MALFUNCTIONS - continued		
FUEL CTL RPM GAIN	#555	Engine rpm exceeds maximum governing rpm (102%).	Engine rpm exceeds maximum indicator reading. HIGH RPM light illuminates if 103% is exceeded.	Increase collective to load rotor and sustain engine/rotor rpm below red line. Reduce throttle until normal operating rpm is obtained. Retard throttle to IDLE, and place governor switch in emergency position. Advance throttle slowly until operating rpm is obtained, and control engine rpm manually by coordinating throttle and collective.	Instructor: FUEL CTL RPM GAIN appears on CRT. Student: Engine rpm indications increase to maximum exceeding safe limits.
FUEL CTL RPM LOSS	Instructor #556	Engine rpm indicates below minimum governing rpm (91%).	Engine rpm remains below minimum governing rpm. LOW RPM warning light illuminates. Audible warning is heard in pilot and gunner headsets.	Enter autorotation and select forced landing area. Check gas producer to ensure engine has not failed. Retard throttle to engine IDLE, and place governor switch in the emergency position. Advance throttle slowly until operating rpm is obtained, and control engine rpm manually by coordinating throttle and collective.	Instructor: FUEL CTL RPM LOSS appears on CRT. Student: Engine rpm remains below 91% until corrective action occurs, at which time normal operation ensures. Audio warning may be disabled with RPM WARNING switch to OFF.
ENG OIL LOSS	#557	Engine oil pressure indication decreases at a rate of 10 psi/minute. ENG OIL PRESS caution light illuminates if pressure drops below 27 psi. ENG OIL BYPASS caution light illuminates, and oil temperature indicator rises abnormally high.	Engine oil pressure indicator decreases at 10 psi/min. ENG OIL PRESS caution light illuminates if pressure drops below 27 psi.	Land at nearest safe area.	Instructor: ENG OIL PRESS LOSS appears on CRT. Student: Engine oil pressure indicator decreases at a rate of 10 psi/minute. ENG OIL PRESS and ENG OIL BYPASS caution lights are on if pressure is below 27 psi. High oil temperature.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			550 ENGINE SYSTEMS MALFUNCTIONS - continued		
ENG STARTER	#558	Defective starter relay results in no engine start rpm response to actuation of starter switch.	No indication or sound of engine start up.	Check ignition keyswitch. Check START RLY CB. Check battery.	Instructor: ENG STARTER appears on CRT. Student: No audible or visible indications of normal start procedure.
P INL GD VANE OPEN	#559	A lag in N_1 occurs when advancing throttle from low to high power settings.	No apparent indication unless power is increased. A noticeable lag in N_1 is experienced with low power setting (N_1 83%).	Avoid rapid power changes. Land as soon as possible at an area that will permit a run-on landing.	Instructor: INL GD VANE OPEN appears on CRT. Student: A noticeable lag in N_1 indication occurs when power is increased.
EP INL GD VANE CLSD	#560	An instantaneous rise in TGT may occur.	If a collective application is made that would normally result in more than 44% torque, N2 (engine and rotor) deteriorates while N1 and TGT increase.	Adjust collective pitch as required to maintain N2 RPM. Jettison wing stores as applicable. Land as soon as practicable at an area that will permit a run-on landing.	Instructor: INl GD VANE CLSD appears on CRT. Student: TGT indication shows instantaneous rapid increase and continues to increase beyond safe operating limits.
NG FUEL PMP	#561	One element of dual element pump fails. ENG FUEL PUMP caution light illuminates.	MASTER CAUTION light illuminates. ENG FUEL PUMP caution light illuminates.	Land as soon as possible at nearest safe landing area.	Instructor: ENG FUEL PMP appears on CRT. Student: ENG FUEL PUMP caution light illuminates.
ENG OIL, BYPASS	#562	Engine oil is bypassing oil cooler. ENG OIL BYPASS caution light illuminates. Engine oil temperature rises. MASTER CAUTION light on.	ENG OIL BYPASS caution light is on. Engine oil temp indicator rises to 120°C at a rate of approximately 20°/sec.	Set ENG OIL BYP switch to off. Oil temperature should decrease.	Instructor: OIL BYPASS appears on CRT. Student: ENG OIL BYPASS caution light illuminates. Engine oil temp indicator rises to 120°C at a rate of approximately 20°/sec.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			550 ENGINE SYSTEMS MALFUNCTIONS - continued		
ENG INL OBST	#563	Engine icing is suspected a loss of power and a rise in TGT.	Loss of engine power and TGT continues to rise. When de-icing is introduced, power is restored to normal in approximately 2 minutes. A rise in TGT occurs when ENG DEICE is used.	Establish IAS at 100 knots or less. Turn on engine DEICE switch.	Instructor: ENG INI, OBST appears on CRT. Student: A rise in TGT and loss of power occur.
BLD BAND STUCK OPEN	#564	When gas generator speed is above 85%, engine indicates lower than normal torque, and N1 and TGT increase. All engine parameters will be normal if main gas generator is reduced below 85%.	When gas generator speed is above 85%, the engine indicates lower than normal torque, and N1 and TGT increase. For engine operation below 80% N1, no abnormal effects are realized.	Reduce power to keep TGT within limits.	Instructor: BLD BAND STUCK OPEN appears on CRT. Student: Lower than normal torque, higher than normal N1 and TGT for power setting.
BLD BAND STUCK CLSD	#565	When gas generator speed is below 78%, engine indicates a loss in N1. An at tempt to accelerate the engine rapidly results in stall characteristics. All engine parameters will be normal if main gas generator is 78% when malfunction is inserted.	When the gas generator speed is below 78%, engine indicates a loss in N1. Any attempts to accelerate engine rapidly results in stall characteristics. All engine parameters will be normal if N1 is above 78% when malfunction is inserted. When engine is stalled, there is a further loss in N1, and an increase in TGT.	Avoid sudden power changes. If sudden power change causes stall, put throttle in flight idle and collective to flat pitch. Stall will then subside and engine can be operated normally with slow power changes.	Instructor: BLD BAND STUCK CLSD appears on CRT. Student: Engine operates normally with slow power changes. If engine is stalled, gas producer indications fluctuate and TGT rises rapidly above safe operating limit.
GOV SW HIGH SIDE	#566	Engine rpm requested prior to failure is adjustable downward, but not upward.	Engine RPM continues to indicate the value prior to failure if rpm increase is attempted. Any decrease will not be adjustable upward.	During engine run-up, shut engine down.	Instructor: GOV SW HIGH SIDE appears on CRT. Student: No greater engine rpm than at time of failure can be selectd with RPM INC/DEC switch.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			550 ENGINE SYSTEMS MALFUNCTIONS - continued		
GOV SW LOW SIDE	#567	Engine rpm requested prior to failure is adjustable upward, but not downward.	Engine RPM continues to indicate the value prior to failure if an rpm decrease is selected. Any attempt to decrease rpm is not possible with GOV INC/DEC switch.	Manage engine by alternate means.	Instructor: GOV SW LOW SIDE appears on CRT. Student: No response to DEC position of GOV INC/DEC switch.
ENG FIRE	#568	FIRE light illuminates, accompanied by excessive TGT for the state of engine operation (start of normal inflight operation).	Fire light is on and TGT is excessive.	If on ground: a. Close throttle b. Fuel switch off c. Motor engine until TGT decreases d. Complete engine shutdown If in flight: a. Land (power off or on depending on circumstances) b. Throttle, fuel, and battery off c. Clear helicopter	Instructor: ENG FIRE appears on CRT. Student: Abnormally high TGT accompanied by FIRE light.
p FIRE LIGHT	#569	FIRE light illuminates, and there are no accompanying signs that a fire exists. Normal TGT, engine operation, electrical, etc. No other systems are affected.	Fire light ON.	If on ground: a. Close throttle b. Fuel switch off c. Motor engine until TGT decreases d. Complete engine shutdown If in flight: a. Land (power off or on depending on circumstances) b. Throttle, fuel, and battery off c. Clear helicopter	Instructor: P FIRE LIGHT appears on CRT. Student: Fire light illuminates.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			550 ENGINE SYSTEMS MALFUNCTIONS - continued		
ENG CHIPS	#570	ENG CHIP and CHIP DETECTION lights illuminate on pilot and gunner caution panel, accompanied by erratic engine operation and excessive oil temperature. Three minutes after initial indication, the engine fails.	ENG CHIP and CHIP DETECTOR lights illuminate, engine [illegible] and torque oscillate erratically, high oil temperature and subsequent engine failure with associated systems.	Land as soon as possible.	Instructor: ENGINE CHIPS appears on CRT. Student: ENG CHIP and CHIP DETECTOR lights illuminate, engine rpm, TGT, and torque oscillate erratically, high oil temperature and subsequent engine failure with associated systems.
ENG CHIPS LIGHT	#571	Shorted engine chip detector causes ENG CHIP light to illuminate on pilot caution panel, and CHIP DETECTOR light on gunner caution panel to illuminate. No effect on aircraft or system operation.	Pilots ENG CHIP light and gunners CHIP DETECTOR light illuminate.	Land as soon as possible.	Instructor: ENG CHIPS LIGHT appears on CRT. Student: ENG CHIP light illuminates at pilot caution panel, CHIP DETECTOR light also illuminates at gunner caution panel.
ICI	#572	Icing is evidenced by a rise in TGT if outside temperature is below 4.4°C. The malfunction input enables icing, if engine de-ice circuit is deenergized. NOTE Vehicle icing occurs automatically (not as a function of instructor input) when the outside temperature reaches below - 0°C and the turbulence level exceeds 6. When this occurs, vehicle drag increases and increased vehicle weight due to ice accumulation requires slightly higher than normal power application.	Above normal TGT. Reduced performance	Turn-on engine DEICE switch.	Instructor: ICI appears on CRT. Student: Higher than normal TGT.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
		550 ENGINE SYSTEMS MALFUNCTIONS - continued			
ICI - continued	#572	NOTE Pitot static icing is incorporated per discussion in Flight Instruments Section (separate malfunction).			
		600 FLIGHT INSTRUMENTS MALFUNCTIONS			
PITOT/STAT STOPAGE	#601	Below Temp. of 4.4°C: Ice of pitot/static system. Airspeed indication decreases toward zero at a rate of 1 knot/second. Above Temp. of 4.4°C: Mechanical stoppage of pitot/static system. Airspeed indication decreased to zero at rate of 1 knot/second.	Pilot and gunner airspeed indicators are inoperative and slowly decrease to zero at 1 knot/second.	Check PITOT HTR CB and set PITOT HEATER switch on.	Instructor: PITOT/STAT STOPAGE appears on CRT. Student: Airspeed indicator initially decreases toward zero. With application of de-icing, normal indications are restored. Mechanical stoppage causes airspeed indications to decrease to zero.
p TRN NDEL	#602	Turn needle inoperative and returns to zero.	Absence of turn needle deflection with changes in heading	Check TURN & SLIP IND CB.	Instructor: TRN ND appears on CRT. Student: NO deflection of turn needle with change in heading.
ADS ICI	#603	Low airspeed indicated. Wind velocity decreases to zero at a rate of 1 knot/second from original value.	Low airspeed indication decreases to zero.	Check PITOT HTR CB.	Instructor: ADS ICI appears on CRT. Student: AI decreases to zero.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			6 SO FLIGHT CONTROL/HYDRAUL IC SYSTEM MALFUNCTIONS		
#1 HYD SYS	#651	#1 HYD PRESS caution light on. MASTER CAUTION light on. Yaw SCAS actuator centers and locks. Directional pedals are stiff but movable (loss of tail rotor boost).	Difficult to make directional changes using pedals.	Ensure emergency hydraulic switch off for both pilot and gunner to prevent depletion of accumulator. Hydraulic control CB in. Check EMER HYD PUMP CB in. SCAS - Disengage YAW channel. MASTER ARM switch to off. Land at nearest available safe landing area. Emergency hydraulic switch to on at final approach. NOTE Due to a possible failure of the operating system caused by fluid seepage into the inoperative system, a running landing is recommended with touchdown speed of 50 knots, terrain permitting.	Instructor: #1 HYD SYS appears on CRT. Student: #1 HYD PRESS caution light on. MASTER CAUTION light on. Difficult to move directional pedals.
#2 HYD SYS	#652	#2 HYD PRESS caution light on. MASTER CAUTION light on.	Increase in difficulty to control pitch and roll due to loss of pitch/roll SCAS.	Ensure emergency hydraulic switch off for both pilot and gunner to prevent depletion of the accumulator. Hydraulic control CB in. Check EMER HYD PUMP CB in. SCAS - disengage pitch and roll channels. MASTER ARM switch to off. Land as soon as practicable. Land at nearest available safe landing area. Emergency collective hydraulic switch on (final approach).	Instructor: #2 HYD SYS appears on CRT. Student: #2 HYD PRESS caution light on. MASTER CAUTION light on. Increased difficulty in control of pitch and roll.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			650 FLIGHT CONTROL/HYDRAULIC SYSTEM MALFUNCTIONS - continued		
#2 HYD SYS	#652			NOTE Due to a possible failure of the operating system caused by fluid seepage into the inoperative system, a running landing is recommended with touchdown speed of 80 knots, terrain permitting.	
BOTH HYD SYS	#653	Indications: #1 HYD PRESS and #2 HYD PRESS caution lights on. MASTER CAUTION light on.	All cyclic and pedal movements difficult. Collective will not move.	Ensure emergency hydraulic switch off for both pilot and gunner to prevent depletion of the accumulator. NOTE If necessary to turn emergency collective hydraulic switch on to maintain a flying aircraft, turn it on and leave it on. If not, wait until final approach. Hydraulic circuit breaker on. Check EMER HYD PUMP CB in. SCAS - disengage all channels. Maintain speed where control forces are manageable. Land at nearest available safe landing area. WARNING Below 20 knots, airspeed cyclic feedback forces become uncontrollable.	Instructor: BOTH HYD SYS appears on CRT. Student: #1 HYD PRESS and #2 HYD PRESS caution lights on. MASTER CAUTION light on. Difficult to change direction, pitch and roll.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			6 SO FLIGHT CONTROL/HYDRAULIC SYSTEM MALFUNCTIONS - continued		
BOTH HYD SYS	#653 - continued			NOTE Execute running landing with speed of 50 knots, terrain permitting.	
P HDOVR	#654	Nose-down moment induced in aircraft due to SCAS actuator full extension.	Student experiences nose-down indications and motion cues.	Disengage entire SCAS system. Reengage unaffected channels. Retrim pitch control (F/A cyclic stick).	Instructor: HDOVR SCAS - PITCH appears on CRT. Student: Experiences initial nose-down pitching. Increased difficulty to control pitch due to loss of SCAS operation.
P HDOVR	#655	Roll right moment induced in aircraft due to SCAS actuator full extension.	Student experiences roll right indications and moment cues.	Disengage entire SCAS system. Reengage unaffected channels. Retrim roll control (lateral cyclic stick).	Instructor: HDOVR SCAS - ROLL appears on CRT. Student: Experiences initial right rolling. Increased difficulty to control roll due to loss of SCAS operation.
P HDOVR SCAS	#656	Left yawing moment induced in aircraft due to SCAS actuator full extension.	Trainee experiences left yawing indications and motion cues.	Disengage entire SCAS system. Reengage unaffected channels. Retrim yaw control (pedals).	Instructor: HDOVR SCAS-YAW appears on CRT. Student: Experiences cockpit yaw left and increased difficulty to control yaw due to loss of SCAS operation.
P MOTOR SCAS-PITCH	#657	Oscillation in pitch axis due to SCAS actuator oscillations.	Continued oscillations in pitch axis if SCAS is not disengaged.	Disengage SCAS pitch channel.	Instructor: MOTOR SCAS-PITCH appears on CRT. Student: Experiences cockpit oscillation in pitch axis.
p MOTOR SCAS-ROLL	#658	Oscillation in roll axis due to SCAS actuator oscillations.	Continued oscillations in roll axis if SCAS if not disengaged.	Disengage SCAS roll channel.	Instructor: MOTOR SCAS-ROLL appears on CRT. Student: Experiences cockpit oscillations in roll axis.
p MOTOR SCAS-YAW	#659	Oscillation in yaw axis due to SCAS actuator oscillations.	Continued oscillations in yaw axis if SCAS is not disengaged.	Disengage SCAS yaw channel.	Instructor: MOTOR SCAS-YAW appears on CRT. Student: Experiences cockpit oscillation in yaw axis.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			650 FLIGHT CONTROL/HYDRAULIC SYSTEM MALFUNCTIONS - continued		
P TOTAL SCAS	#660	All SCAS inputs to control systems are removed.	Continued difficulty in maintaining trimmed and stable attitude.	Turn SCAS master POWER switch off. Return to base.	Instructor: TOTAL SCAS appears on CRT. Student: Experiences sudden increase in difficulty to maintain stable attitude due to loss of SCAS operation.
			700 FUEL SYSTEM MALFUNCTIONS		
p FUEL QTY IND ZERO	#701	Instrument reading decreases to zero. No other effect on system operation.	Fuel pressure indication goes to zero.	Check fuel quantity with PRESS-TO-TEST switch. Check A/C FUEL QTY CB.	Instructor: FUEL QTY IND ZERO appears on CRT. Student: Fuel pressure indicator goes to zero.
p FUEL QTY IND STCK	#702	Instrument fails in last position and is inoperative. No other effect on system operation.	Fuel quantity indicator remains fixed and does not vary with fuel usage.	Check fuel quantity with PRESS-TO-TEST switch. Check A/F FUEL QTY CB.	Instructor: FUEL QTY IND STCK appears on CRT. Student: Fuel quantity indicator remains fixed in last position and does not vary with diminishing fuel.
P FWD BST PMP	#703	FWD FUEL BOOST caution light on. Fuel pressure may decrease. MASTER CAUTION light on.	FWD FUEL BOOST caution light on. Fuel pressure indication may drop to a lower value. MASTER CAUTION light on.	Pull to open FWD FUEL BOOST CB. If above 6000 feet, descend to below 6000 feet. Avoid nose-down attitude if greater than 15° if less than 320 lbs of fuel remain.	Instructor: FWD BST PMP appears on CRT. Student: FWD FUEL BOOST caution light on. Fuel pressure may decrease. MASTER CAUTION light on.
p AFT BST PMP	#704	AFT FUEL BOOST caution light on. MASTER CAUTION light on.	AFT FUEL BOOST caution light on.	Pull to open AFT FUEL BOOST CB. If above 6000 feet, descend to below 6000 feet.	Instructor: AFT BST PMP appears on CRT. Student: AFT FUEL BOOST caution light on. MASTER CAUTION light on.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference	Aircraft indications	Effects sensed by student(s) if corrective	Required corrective	Indications presented to instructor/operator
			700 FUEL SYSTEM MALFUNCTIONS - continued		
p CNTMTD FUEL FLTR	#705	FUEL FILTER caution light comes on. Fuel bypass valve opens to allow fuel to bypass clogged filter. MASTER CAUTION light on.	FUEL FILTER caution light comes on. MASTER CAUTION light on.	Land at nearest available safe landing area.	Instructor: CNTMTD FUEL FLTR W appears on CRT. Student: FUEL FILTER caution light comes on. MASTER CAUTION light on.
			750 ROTOR/TRANSMISSION MALFUNCTIONS		
puel LOW LIGHT	#706	Short in low-level circuit causes FUEL LOW caution light to illuminate. MASTER CAUTION light also illuminates. No other effects on system.	Caution lights remain illuminated. Fuel quantity indicator provides valid fuel indication.	Land as soon as possible.	Instructor: FUEL LOW LIGHT appears on CRT. Student: FUEL LOW caution light illuminates.
p puel OVRCNSMP	#707	Fuel consumption rate is 1000 lbs/hour regardless of power requirements.	Rapid decrease shown on quantity indicator.	Land prior to illumination of the FUEL LOW caution light.	Instructor: FUEL OVRCNSMP appears on CRT. Student: Excessive fuel consumption rate is noted.
MN RTR TRCK	#751	Vertical vibrations.	Vertical vibrations.	Land as soon as possible.	Instructor: MN RTR TRCK appears on CRT. Student: Experiences cockpit vertical vibration in seat.
MN RTR BAL	#752	Lateral and rolling vibrations.	Lateral and rolling vibrations.	Land as soon as possible.	Instructor: MN RTR BAL appears on CRT. Student: Experiences cockpit lateral and rolling vibration in seat.
TL RTR HI FRQ VIBR	#753	High-frequency vibrations at tail section.	High-frequency pedal flutter.	Land as soon as possible.	Instructor: TL RTR HI FRQ VIBR appears on CRT. Student: Experiences vibrations in seat.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			.750 ROTOR/TRANSMISSION MALFUNCTIONS - continued		
LOSS OF RL RTR	#754	Nose-down moments induced in aircraft. Center of gravity shift occurs. Loss of all tail rotor control.	Student experiences pitch down, yaw right, and roll left indication and motion cues.	Perform autorotational landing.	Instructor: LOSS OF TL RTR appears on CRT. Student: Experiences cockpit pitch down, yaw right, and roll left. Pedal movement has no effect on flight.
TL RTR PITCH FIXED PITCH	#755	Loss of tail rotor pitch control.	When power and/or trim is changed, aircraft yaws. Student experiences loss of directional control, and pedals are frozen.	Control helicopter by means of cyclic throttle and collective.	Instructor: TL RTR FIXED appears on CRT. Student: Experiences loss of directional control.
P XMN-OIL PRES HIGH	#756	Instrument pressure indication increases abnormally high. No other effect on system.	Transmission oil pressure indicator increases to 1000 psi.	Land as soon as possible.	Instructor: XMSN OIL-PRES HIGH appears on CRT. Student: Transmission oil pressure indicator decreases to zero at a rate of approximately 10 psi/minute.
P XMN OI I,- TMP HIGH	#757	Open circuit in thermosense bulb causes instrument to indicate high temperature. No other effect on system.	Transmission oil temperature indicator increases to 120°C at a rate of 30°C/second. (Normal temperature is approximately 78°C.)	Land as soon as possible.	Instructor: XMN OIL-TMP HIGH appears on CRT. Student: Transmission oil temperature indicator increases to 120°C at a rate of 30°C/second.
XHN OIL PRES LOSS	#758	Transmission oil pressure drops to 0 psi. Indicator reads zero, and TRANS OIL PRESS caution light is on when pressure is less than approximately 30 psi. Oil circulation stops.	Transmission oil pressure indicator reads zero, and TRANS OIL PRESS caution light is on. MASTER CAUTION light on. High transmission temperature indication and associated caution lights are on.	Land immediately. Maintain power throughout approach and landing.	Instructor: XNN OIL PRES LOSS appears on CRT. Student: Transmission oil pressure indicator reads zero. XMSN OIL PRESS caution light illuminates.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			7SO ROTOR/TRANSMISSI_ON MALFUNCTIONS - continued		
XMN OIL BYPASS	#759	TRANS OIL BYPASS caution l ight on. Transmission oil is bypassing OIl cooler. Transmission oil temperature rises. MASTER CAUTION light on ·	TRANS OIL BYPASS light on. MASTER CAUTI ON light on. Tr ansmi ssion oil temperature i ndicator increases to 120°C at a rate 0Ɛ approximately 20 °C/second.	Land immediately. Maintain power throughout approach and landing.	Instructor: XMN OIL BYPASS caution light illuminates. Transmission oil temperature indicator increases to 120°C at a rate of approximately 20°C/second.
SHORT SHAFT	#760	Shaft between engine and transmission has sheared. Engine rpm abruptly increases. Rotor rpm decreases.	Loss of power to main and tail rotor. Low rpm audible warning. RPM warning light on.	Close throttle immediately. Follow procedures for autorotation landing.	Instructor: SHORT SHAFT appears on CRT. Student: Effects 0Ɛ loss 0Ɛ engine power. Engine rpm abruptly incr eases. Rotor rpm decreases.
90 DEG GR BOX LOSS	#761	Loss of tail rotor.	When power is changed and/or trim is changed, aircraft yaws. Student experiences loss of directional control, and pedals are frozen.	Control helicopter by means of cyclic throttle, and collective.	Instructor: 90 DEG GR BOX LOSS appears on CRT. Student: Experiences loss of directional control.
TL RTR THRUST LOSS	#762	Break in drive system results in nose right (left sideslip) and roll left, with no response to pedal inputs.	Nose right, left roll cues (motion, visual, instruments) · No response to pedal inputs.	Perform autorational landing.	Instructor : TL RTR THRUST LOSS appears on CRT. Student: Experiences nose right, left roll cues (motion, visual instruments) and no response to pedal inputs.
RTR ICE	#763	Ice accumulates on main rotor blades requiring increased power to maintain altitude. Outside air temperature is less than 4.4°C. Assymetrical shedding of ice as aircraft enters warmer OAT. Lateral and rolling vibrations.	Increased torque to maintain altitude and airspeed.	Descend or climb to warmer air. Land as soon as possible if condition continues or vibration is too great.	Instructor: RTR ICE appears on CRT. Student: Increased power requirement. Lateral and rolling vibration.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			750 ROTOR/TRANSMISSION MALFUNCTIONS - continued		
XMN CHIPS	#764	TRANS CHIP and CHIP DETECTOR lights illuminate, accompanied by increase in transmission noise, rise in transmission oil temperature, and illumination of TRANS OIL HOT lights.	TRANS CHIP and CHIP DETECTOR lights illuminate. Transmission noise increases, transmission oil temperature increases above normal, and the TRANS OIL HOT light illuminate.	Land as soon as poss ible.	Instructor: XNN CHIPS MALF appears on CRT. Student: TRANS CHIP, CHIP DETECTOR, TRANS OIL HOT lights all illuminate. Increase in transmission sound and increase in transmission oil temperature indication.
XMN CHIPS LIG	#765	A short in detector output causes TRANS CHIP light on pilot caution panel and the CHIP DETECTOR light on gunner caution panel to illuminate. No other effects on systems operation.	TRANS CHIP and CHIP DETECTOR caution lights on.	Land as soon as possible.	Instructor: XMN CHIPS LIG appears on CRT. Student: TRANS CHIP and CHIP DETECTOR caution lights illuminate at caution panels.
			800 WEAPONS SYSTEMS MALFUNCTIONS		
20 MN FAIL/ FIRE	#801	None	20mm fails to fire.	Use different weapon.	Instructor: ZONN FAIL/FIRE appears on CRT. Student: 20 mm fails to fire.
20MM RUNAWAY	#802	None	20mm continues to fire after trigger relase.	Remove arm or appropriate circuit breaker(s).	Instructor: 20MM RUNAWAY appears on IOS. Student: Weapon continues to fire.
7.62 FAIL/ FIRE (LT) 7.62 FAIL/ FIRE (RT)	#803 (LT) #804 (RT)	None	Affected 7.62mm wing pod fails to fire.	Use remaining weapons.	Instructor: 7.62 FAIL/FIRE (LT) or (RT) appears on CRT. Student: 7.62mm fails to fire.
7.62 RUNAWAY (LT) 7.62 RUNAWAY (RT)	#805 (LT) #806 (RT)	None	Affected 7.62mm wing pod continues firing after release of FIRE switch.	Remove arm or appropriate circuit breaker(s).	Instructor: 7.62 RUNAWAY (LT) or (RT) appears on CRT. Student: Weapon continues to fire.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			800 WEAPONS SYSTEMS MALFUNCTIONS		
JAMMED GUN TURRET	#807	None	Turret weapon fails to fire.	Use another weapon.	Instructor: JAMMED GUN TURRET appears on CRT. Student: Turret jammed.
TOW FAIL/FI RE	#808	None	TOW missile fails to fire.	Use different weapons or select next missile.	Instructor: TOW FAIL/FIRE appears on CRT. Student: TOW misfire.
TOW HANG FIRE	#809	None	Next TOW fired burns in in tube causing yaw moment.	Gain control of helicopter. Perform hang fire procedure.	Instructor: TOW HANG FIRE appears on CRT. Student: Tow hang fire.
2.75 FAIL/ FIRE (LO) 2.75 FAIL/ FIRE (LI) 2.75 FAIL/ FIRE (RI) 2.75 FAIL/ FIRE (RO)	#810 #811 #812 #813	None	Rockets from affected station fail to fire.	Use other stations to perform mission. Maintain control of asymmetrically loaded helicopter.	Instructor: 2.75 FAIL/FIRE (LO, LI, RI, or RO) appears on CRT. Student: Bit of RMS shows failed SU at affected station.
2.75 HANG FIRE (LT) 2.75 HANG FIRE (RT)	#814 #815	None	Next rocket fired from appropriate side burns in tube causing yaw moment to helicopter.	Gain control of helicopter. Remove fire signals.	Instructor: 2.75 HANG FIRE (LT or RT) appears on CRT. Student: Rocket hangs in tube.
FCC FAIL	#816	HUD shows raw laser range.	Total loss of FCC aiming corrections and ballistic calculations. FCC INOP on caution panel.	Estimate required aiming corrections.	Instructor: FCC FAIL appears on CRT. Student: Loss of FCC.
HUD FAIL	#817	Pilot must estimate aim angle.	Total loss of HUD image.	None.	Instructor: HUD FAIL appears on CRT. Student: Loss of HUD.
ALT FAIL	#818	None	None	Find target manually.	Instructor: ALT FAIL appears on CRT. Student: ALT fails test mode.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference number	Aircraft indications and related effects	Effects sensed by student(s) if corrective action is not taken	Required corrective action	Indications presented to instructor/operator and student
			800 WEAPONS SYSTEMS MALFUNCTIONS - continued		
LRF FAIL	#819	LRF fails to provide range to target.	Loss of LRF data in TSU.	Manually estimate range.	Instructor: LRF FAIL appears on CRT. Student: Loss of LRF.
RMS FAIL	#820	None	Rockets fire in mode single quantity, all regardless of panel selection. If Bit run, center digit blanked ICDU Fail.	Remove fire signal and/or power. Change firing modes to use single, all.	Instructor: RMS FAIL appears on CRT. Student: Performing BIT on RMS shows failed ICDU.
LASER FAIL	#821	Laser is inoperative. Laser range not fed to HUD through FCC.		Requires estimating range to target.	Instructor: LASER FAIL appears on CRT. Student: HUD indicates nonbased range supplied.
AN/ASR 39 IND	#822	AN/APR 39 radar warning set gives erroneous test indications. In normal operation, no signals from left fwd quadrant.			Instructor: P AN/APR 39 IND appears on CRT. Student: When tested, APR 39 gives wrong test indications.
PARTIAL HUD FAIL	#823	Partial failure of HUD symbology.	No floating reticle.	Switch mode to use stadiametric reticle for weapons firing.	Instructor: PARTIAL HUD FAIL appears on CRT. Student: No reticle symbology in direct or indirect normal position.
G TOW BIT - MCA FAIL	#824	Upon completion of TOW BIT sequence, MCA fail indication appears.		Remove MALF, and reinitiate BIT.	Instructor: G TOW BIT - MCA FAIL appears on CRT. Student: White MCA indication on TOW control panel.
G TOW BIT - EPS FAIL	#825	Upon completion of TOW BIT sequence or upon selection during use, EPS fail indication appears.		Remove MALF, and reinitiate BIT.	Instructor: G TOW BIT - EPS FAIL appears on CRT. Student: White EPS indication appears on TOW control panel.

Table 7-3. Simulated Malfunction Details - Continued

Malfunction	CRT reference	Aircraft indications	Effects sensed by student(s) if corrective	Required corrective	Indications presented to instructor/operator
		800 WEAPONS SYSTEMS MALFUNCTIONS - continued			
G TOW BIT - SCA FAIL	#826	Upon completion of TOW BIT sequence ,SCAfail indication appears.		Remove MALF, and re-initiate HSS BIT test.	Instructor: G TOW BIT - SCA FAIL appears on CRT. Student: White SCA indication appears on TOW control panel.
G TOW BIT - TSU FAIL	#827	Upon completion of TOW BIT sequence, TSU fail indication appears.		Remove MALF, and re-initiate HSS BIT test.	Instructor: G TOW BIT - TSU FAIL appears on CRT. Student: White TSU indication appears on TOW control panel.
P HSS BIT - FAIL	#828	Upon completion of HSS BIT sequence, PLT lights, indicating failure in pilot helmet linkage. System cannot be fired with gunners HSS.		Remove MALF, and re-initiate HSS BIT test. Check pilot rails connected to bit position. Reinitiate HSS BIT test.	Instructor: P HSS BIT - FAIL appears on CRT. Student: PLT illuminates on armament control panel.
G HSS BIT - FAIL	#829	Upon completion of HSS BIT sequence, GNR lights, indicating failure in gunner helmet linkage. System cannot be fired with gunners HSS.		Check gunner HSS rails connected to BIT position. Reinitiate a HSS BIT test.	Instructor: G HSS BIT - FAIL appears on CRT. Student: GNR illuminates on armament control panel.
PHSS RETICLE FAIL G HSS RETICLE FAIL	#830 #831	During HSS reticle test, (pilot or gunner) reticle indicates failure of one filament.			Instructor: P or G HSS RETICLE FAIL appears on CRT. Student: When HSS reticle test is conducted reticle goes out.
HSS BIT - EIA FAIL	#832	Upon completion of HSS BIT sequence, EIA lights, indicating a failure. System cannot be fired.		Reinitiate HSS BIT test.	Instructor : HSS BIT - EIA FAIL appears on CRT. Student: EIA illuminates on armament control panel.

Section VI. CRT DISPLAYS

7-34. GENERAL. The CRT display system consists of two identical CRT consoles, one at each instructor station. The CRT display is formatted as shown in figure 7-34. Each section of the display format is devoted to certain tasks. Display selection at each CRT is under the control of the respective instructor or, in some cases, the student. Any display on the CRT can be stored in disk memory and printed out by the hardcopy printer for discussion with the crew at the conclusion of the exercise. Twenty such recordings (shared by both cockpits) can be requested for printout by the instructor/operator(s) during a training exercise. The CRT display has controls for focus and intensity.

7-35. DISPLAY FORMATS. As shown in figure 7-35, each display is divided into two major areas. The upper 4- by 12-inch area of the display contains both graphic and alphanumeric data which provides status of the training exercise. The lower 12- by 12-inch area displays instructional text, parameter lists, maps, and data pages used to execute, monitor, and edit the training program.

a. The upper area of the display contains in the center, a continuously updated graphic representation of the 12 preceding minutes of helicopter airspeed and altitude data. The altitude scale can be set for either 0-to-2,000 feet or 0-to-4,000 feet. Immediately to the left, information is provided regarding the operating mode, freeze or crash indication, and the radio and frequency channel used for the last pilot and/or gunner transmission. Below this is a listing of the malfunction that may be currently selected on the console thumbwheel and a list of up to five active malfunctions previously inserted. On the far right is an indication of any parameters that are frozen or are out of tolerance. Frozen parameters are visually indicated with a brighter intensity level, and out-of-tolerance parameters blink. Immediately below are current environmental status, fuel information, and an indication of the number of plots stored. A mission elapsed time (MET) readout (in hours, minutes, and seconds) and a resettable timer (in minutes and seconds) are also provided.

b. The lower 12- by 12-inch area of the CRT can contain maps, instructional text, initial conditions and parameters, checkride and demonstrations, weapons control information, and data pages as called up by the instructor/operator. A CRT index display is available to present to the instructor a listing of the various pages of data available. The index shown in figure 7-2 is automatically displayed when the flight simulator is initially turned on or can be called up for display by simply depressing the ENTER key at the IOS console.

(1) Various displays presented in the lower portion of the CRT are grouped into the categories listed on the CRT index page. Typical CRT display pages are shown throughout this chapter and are discussed in the applicable chapter/section referenced in the table of contents.

(2) In addition to the displays listed in the index, four miscellaneous instruction pages are available. These displays contain miscellaneous information messages relating to editing, freezing, NAV facilities, initial conditions, off-line mode, and integrated mode information. The instructions are incorporated throughout this manual as applicable. The information pages are not listed on the index page and are accessed by actuating the DISPL ADV switchlight when the index is displayed. (These pages are shown in figures 7-4 through 7-7.)

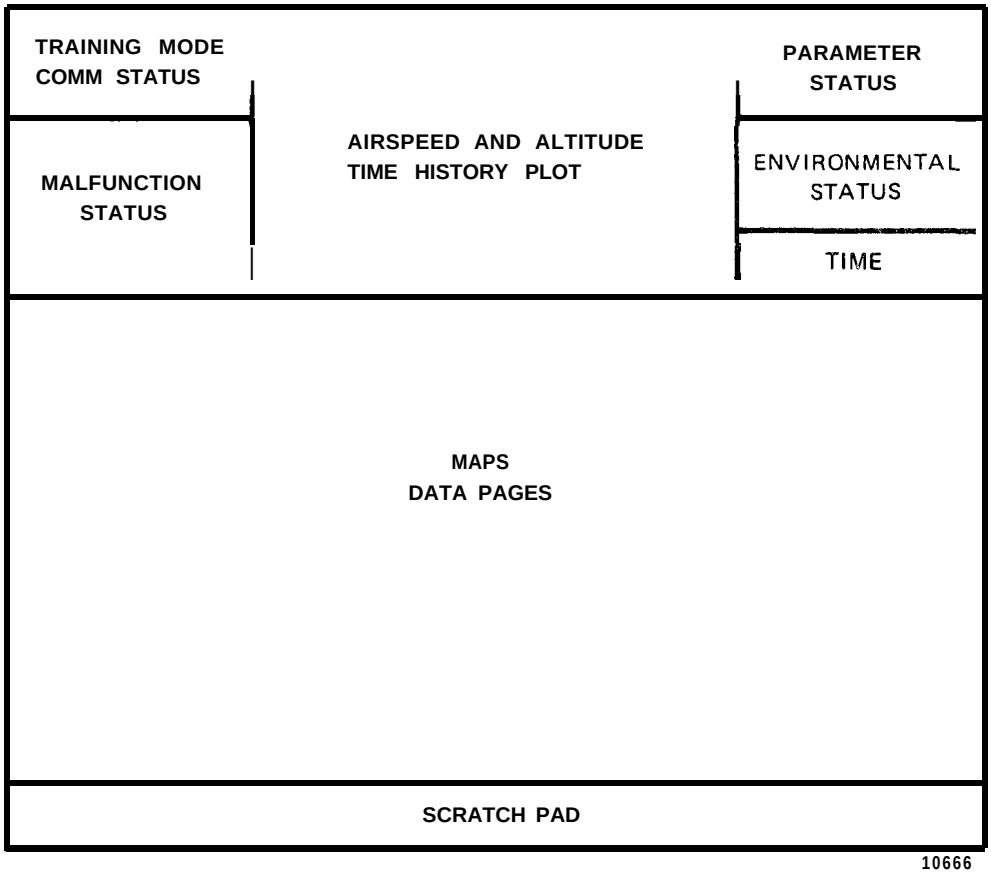


Figure 7-35. Format of CRT Display

c. The bottom l-inch strip is reserved as a scratchpad for edit and error messages on pages where editing is possible. By use of the IOS console control panels, the instructor can select and/or modify CRT page data. If the instructor enters a parameter or modification to the data that is not proper or is outside reasonable tolerances, one of several error messages appears at the bottom of the CRT as appropriate, prompting the instructor/operator that the entry is not in effect. A few error messages are listed below for familiarity:

INVALID LINE NUMBER
INPUT EXCEEDS LIMITS FOR LINE
GUNNER CANNOT EDIT THIS PAGE
AUDIO NOT READY-REWINDING
MUST BE IN FREEZE TO CHANGE MODE
SNAPSHOTS REMAIN FROM PREVIOUS MODE

7-36. CONTROL\DISPLAY INTERRELATIONSHIPS. Both the keyboard and thumbwheel are available to the instructor for initiation and control of the automated training features.

a. The keyboard is used to display and edit pages. The thumbwheel is used to insert/delete initial conditions, maps, malfunctions, demonstrations, and checkrides. Maps can be called up either through the keyboard or thumbwheel. Weapons configuration and ranges can be displayed only through the keyboard. Keyboard ENTER or ZERO, ENTER brings up the index page-on the CRT. Then DISPL ADV steps through a series of instructions pages.

b. The process of selecting a CRT page for inspection consists of typing on the keyboard the desired page number and depressing ENTER. Map pages, GCA displays included, can also be selected by setting the desired page number on the thumbwheel and depressing the INSERT switchlight. When the desired tabular data is displayed on the CRT, a line on any editable page can be modified by typing at the IOS keyboard, the (Line No.), space, (New Value), ENTER.

c. Table 7-4 contains information related to the selection and editing of specific displays.

d. Two displays can be alternately selected by use of the DISPL INTERCHANGE switchlight. Activation of the switchlight alternately displays the most recent selection in each of two groups. One group consists of area maps and the other group consists of data pages, GCA, and weapon/target displays. Displays that appear on the CRT during the checkride mode are preprogrammed.

Table 7-4. IOS Control/Display Interrelationship

Display	Contents	Display callup
INDEX DISPLAY	Identifies 10 IC sets, approach maps, demos, checkrides, malfunction categories, weapon/target displays, and nav/comm radio data tables that exist in the computer and indicates thumbwheel position required for selection of the displays. Thumbwheel position required for selections resides on malfunction category pages.	Type O on keyboard. Type ENTER. NOTE It may be necessary to depress INTERCHANGE DISPL switch.
INSTRUCTION PAGES	Provides miscellaneous information plus editing, freezing, nav facilities, initial conditions, off-line mode, and integrated mode information.	Type O on keyboard. Type ENTER. Depress DISPL ADV. NOTE It may be necessary to depress INTERCHANGE DISPL switch.

Table 7-4. IOS Control/Display Interrelationship – Continued

Display	Contents	Display callup
1 thru 10 INITIAL CONDITIONS	Identifies conditions which represent each of 10 preprogrammed IC sets that can be assigned for trainer initialization or reassigned to set 11 for modification.	Type 1–10 on keyboard. Type ENTER. Once IC set is displayed, it can be assigned to set 11 by typing 11, space, ENTER.
20 PARAM/FRZ/ENVIR (current conditions)	Identifies status of aircraft flight parameters (current value), aircraft location, aircraft weight and balance, weight of fuel, weapon configuration, and environmental conditions. When a parameter is frozen, an asterisk appears between the line number and test.	Type 20 on keyboard. Type ENTER. To freeze parameter On keyboard: Type LINE NUMBER Type SPACE Type * Type ENTER To unfreeze parameter On keyboard: Type LINE NUMBER Type SPACE Type ENTER To edit parameter On keyboard: Type LINE NUMBER Type SPACE Type DESIRED VALUE Type ENTER
21 VISUAL CONDITIONS (current conditions)	Provides status and control of additional visual parameters and conditions not found on the IOS visual system control panels. This CRT page covers atmospheric conditions, runway selection and lighting, hostile ground fire selection, and visual system configuration and assignment.	Type 21 on keyboard. Type ENTER. To edit or select a parameter On keyboard: Type LINE NUMBER Type SPACE Type DESIRED VALUE Type ENTER
23 TARGET ENGAGEMENT POINTS (TEP)	Informational list showing the latitude, longitude, heading, and altitude for each of the available TEP's. Also shows which of the 26 available targets are visible from the TEP's.	Type 23 on keyboard. Type ENTER.

Table 7-4. IOS Control/Display Interrelationship - Continued

Display	Contents	Display callup
25 THREAT ARMY	Provides two related configuration pages of 10 radar emitter threats.	Type 25 or 26 on keyboard. Type ENTER. To edit or select a parameter On keyboard Type LINE NUMBER Type COLUMN NUMBER Type SPACE Type DESIRED VALUE Type ENTER
26 THREAT WINDOW ARRAY	These pages provide the type, activity level, location, and scanning window parameters. Power status of the APR-39 system is also indicated.	
30 through 40 AREA MAPS	Selected game centered cross-country or approach maps are drawn in CRT display. The cross-country map represents a 128 x 128 nautical mile area. Approach maps represent a 32 x 32 nautical mile area.	Select desired map number on thumbwheel. Depress INSERT switchlight, or type desired map number on keyboard. Type ENTER.
EXPAND MAP	The map area can be expanded by a factor of 2X and 4X.	Depress PLOT CHANGE switchlight.
RECENTER MAP	Aircraft-centered plots can be selected. The center of the display is drawn at A/C location at instant of switch depression.	Depress ACFT CENTER switchlight.
45 GCA	Indicates aircraft track and profile, and provides information to instructor air traffic control. Assigns stylized glideslope plot display for the landing approach.	Select 45 on thumbwheel selector. Depress INSERT switchlight, or type 45 on keyboard. Type ENTER.

Table 7-4. IOS Control/Display Interrelationship - Continued

Display	Contents	Display callup
50 TACTICAL MAP	Provides tactical map display of the model board. Map indicates the location of 9 TEP's, 26 targets to be scored upon, 24 hostile ground fire locations, and 3 radar emitter threats. A small rectangle represents the model board airfield and a cross defines aircraft location. A flight track plot is provided to give current location of the aircraft.	Type 50 on keyboard. Type ENTER.
60 CONFIGURATION DISPLAY (weapons)	Identifies 10 different weapon loading configurations available for loading onboard.	Type 60 on keyboard. Type ENTER.
61 PERFORMANCE	Provides weapon scoring data for selected target range or area targets including target number, weapon type, range in meters, direction of hit from target, number of hits, and number of rounds fired. Weapon configuration, target selection, moving target, and other parameters can be edited on this page.	Type 61 on keyboard. Type ENTER.
62 STUDENT HISTORY	Provides summarized result of the crew firing upon up to three targets with up to three different weapon configurations. (Quite often hardcopy printed for follow-up crew evaluation.)	Type 62 on keyboard. Type *ENTER.*
70, 80, 90, and 100	Identifies four major checkrides and the segments within the checkrides that can be selected Brief description of checkride segments is given.	Type desired display number on keyboard. Type ENTER.
MALFUNCTIONS 350 AVIONICS 400 CIRCUIT BRKRS 480 ELECT SYS 500 ENGINE INST 550 ENGINE SYS 600 FLIGHT INSTS 650 FLT CONT/HYD SYS 700 FUEL SYS 750 ROTOR/XMISSION 800 WEAPON SYS	Identifies all possible malfunctions and selection numbers for a particular system that can be selected for insertion during training.	Type malfunction page number on keyboard. Type ENTER.

Table 7-4. IOS Control/Display Interrelationship - Continued

Display	Contents	Display callup
NAV/COM FACILITIES 910 LF/ADF 920 VOR 930 GCA 940 ILS-LOC 950 ILS-OM 960 ILS-MM 970 FM	Identify radio facility data that can be inspected on subpages for each Nav station type and can be edited to disable/enable radio facility. Any facility that is disabled by insertion of an asterisk between the line number and the test.	Type FACILITY NUMBER on keyboard. Type ENTER . To disable station On keyboard: Type LINE NUMBER Type SPACE Type * Type ENTER To enable station On keyboard: Type LINE NUMBER Type SPACE Type ENTER
ALTITUDE AND AIRSPEED PLOT	A plot of altitude and airspeed performance during the preceding 12 minutes of flight. Both traces are plotted against a common reference. Elapsed time is along the horizontal dimension. The 12 minutes of history accumulates from right to left. The vertical dimension presents 0-180 knots of airspeed and 0-2000 or 0-4000 feet of altitude. The altitude scale plot is changed by depression of PLOT SCALE CHANGE switchlight.	Automatic (not freeze)
GROUND PLOT	A ground track plot on the selected cross-country, tactical, or approach map is produced as appropriate. A maximum of 20 linear inches of trace history in either cross-country or approach mode are plotted and retained for recall.	Automatic (not freeze)
TRACK HISTORY ERASE	Erases ground track at a constant rate. Erasure starts at oldest history on selected plots. Function of this option is to unclutter display. Selection of another scale or approach redraws all relevant track history.	Depress and hold TRACK ERASE switch-

Table 7-4. IOS Control/Display Interrelationship - Continued

Display	Contents	Display callup
CHECKRIDE EXERCISE LEG	During checkride, student performance values, including out-of-tolerance parameters, are displayed for each checkride exercise leg. Applicable conditions, parameter values, and tolerances that are checked by the computer are also displayed. This same information is made available automatically in hardcopy printout form.	Automatic

Section VII. AUDIO RECORD/PLAYBACK AND PERFORMANCE RECORD/PLAYBACK

7-37. GENERAL . The audio and performance record/playback system is under instructor and/or computer control in both independent and integrated modes. The system provides: recording and playback for up to the last 5 minutes of elapsed time of crew and instructor radio communication; automatic playback of prerecorded verbal commentary for preprogrammed flight demonstrations; and playback of prerecorded briefings during checkrides. Audio is stored on tape cassettes, and the flight performance in disk memory.

7-38. DYNAMIC RECORD/PLAYBACK. The FWS system can update and store 5 minutes of current performance history on computer disk. Synchronized audio is provided by ten record/playback tape units (five for each cockpit). The tapes provide the last 1, 2, 3, 4, or 5 minutes of audio over the communications system. In the integrated mode, only the pilot record/playback equipment is operational.

a. Audio is recorded automatically when the FWS is not in freeze and a microphone is keyed.

b. Playback of synchronized audio and performance history can be initiated by depressing FREEZE and then the desired number (1 to 5 minutes) switchlight on the PERFORMANCE PLAYBACK panel. The FREEZE switchlights blink, and the FWS initializes to the conditions of the point selected. When ready, FREEZE switchlights illuminate steady. Depress FREEZE to extinguish switchlight and initiate playback.

7-39. DEMONSTRATION PLAYBACK. Twenty playback-only tape units provide demonstration audio. Each tape unit is available for playback to either the pilot or gunner in independent mode. Any one of the twenty tapes are available to both pilot and gunner in integrated mode. In the integrated mode, both receive the same demonstration audio. These playback-only units are synchronized with the playback of flight performance information from computer disk memory.

7-40. CHECKRIDE BRIEFING PLAYBACK. Four playback-only tape units are arranged in a common assembly for checkride briefings. In the independent mode, the four playback-only units are available to the pilot only. In integrated mode, both pilot and gunner receive the same checkride briefing. Briefings are played back automatically when a checkride is initiated.

CHAPTER 8

OFF-LINE MODIFICATIONS OF FLIGHT SIMULATOR PROGRAMS

Section I. CHECKRIDE EDIT AND FORMULATION

8-1. GENERAL DESCRIPTION. To formulate or edit a checkride exercise, this section provides the detailed procedure necessary to create or make a revision. The checkride problem formulation operating system (PFOS) provides a means to describes, in terms familiar to instructor pilots, the performance parameters, etc., required to completely assemble a checkride. This is accomplished by formulating the entire checkride on a deck of punch cards. The scenario is divided into distinct parts or maneuvers called segments. These segments contain various aircraft maneuvers to be monitored, the values expected, and the conditions which must be met for the segment to end and advance to the next segment. As an example, assume that during a particular segment (# 008), the airspeed and rate of climb are monitored for acceptable values of 75 knots and 400 ft/min., respectively. When the aircraft has climbed to 1200 feet, the segment and monitoring of IAS and ROC will end, thereby beginning the next segment. On punch cards this would appear as:

008 CLIMB ALT > 200' IAS 75+-10 KTS

8-2. PFOS SYSTEM DESCRIPTION. Figure 8-1 illustrates the pieces which make up the checkride PFOS system. The following briefly describe each block.

a. Inputs.

(1) NAVø4ø.CIL - RADIO STATION DATA FILE
This file provides a common data base containing the station parameters of all navigation facilities of interest. Within the file, each station's data set is identified by a station index number. This station index number is used to access the data for a particular station.

(2) PFOS.CDS - CHECKRIDE DATA DECK
This is the main input to the program, and the primary topic of this section. The format of information on these cards is shown in figure 8-2 and is described in detail in this section.

b. Processing. The CKRIDE program checks the data deck for conformity to the expectant structuring, compiles this data into a usable machine-coded format, and supplies a CRT display page file reflecting the data deck with syntax error reporting.

c. Outputs.

(1) YCR2øη.DIR - EXERCISE FILE
This file assists the training mode checkride program in exercise control (= ø for VFR, η = 1 for WPNS).

(2) YCR2øη.DIR - PROGRAM DATA FILE
This file contains the machine-coded parameters described in the data deck (η = = 2 for VFR, η = 3 for WPNS).

(3) YCR2ø - CHECKRIDE DISPLAY TEXT
This file contains the text to be displayed on the CRT during the execution of the checkride mode (= 4 for VFR, η = 5 for WPNS).

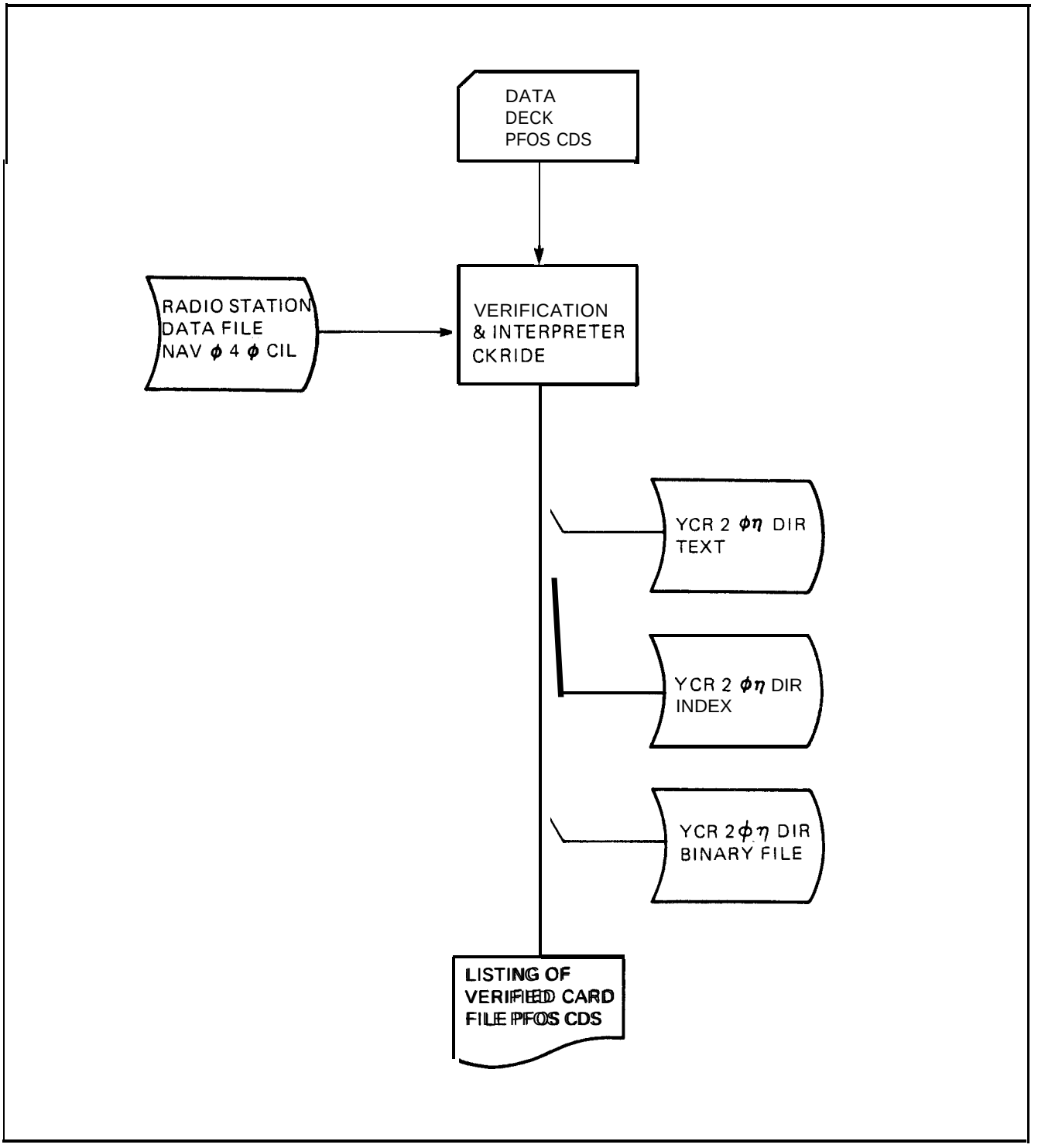


Figure 8-1. Checkride PFOS Functional Block Diagram

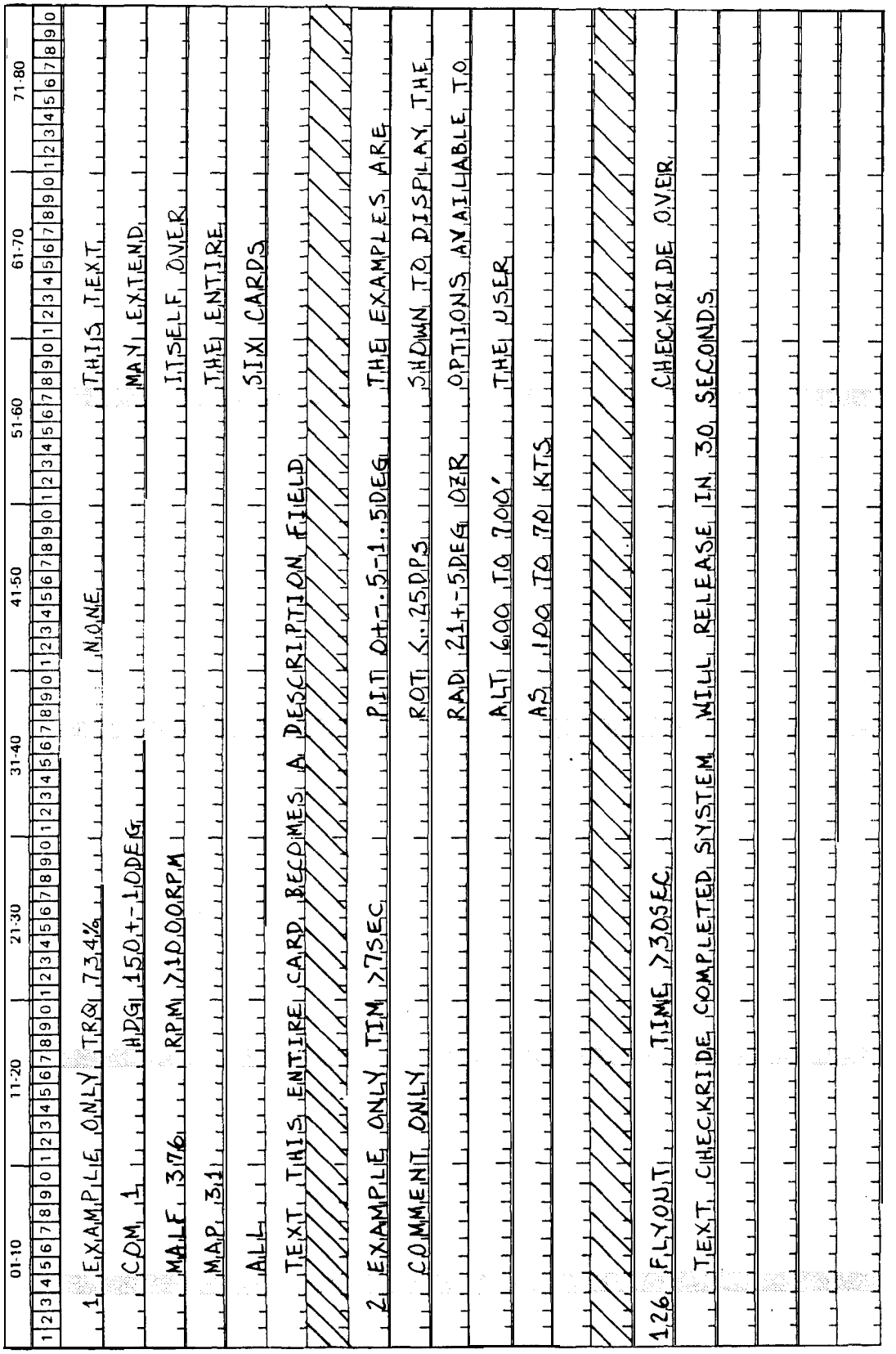


Figure 8-2. Typical Checkride Data Input Keypunch Form

(4) PFOS.CDS - LISTING
Printed copy for immediate syntax error detection.

8-3. OPERATIONAL ENTRY AND CONTROL

a. To Formulate an Entire Checkride

(1) Review the data format part of this section (8-3c).

(2) Review the computer listing for an existing checkride. This will be the quickest way to get familiar with the format and technique.

(3) Plan the checkride on paper (figure 8-3) in detail as if it were going to be flown in the real aircraft. All parameters which are to be monitored during various phases of the flight should be noted.

(4) Break the checkride into exercises. A checkride can be made up of nine exercises, each of which may have its own initial conditions. The checkride begins with an exercise in the first segment, The exercise may be of any length and will end upon the selection of the next exercise or upon the end of checkride. In this manner no two exercises will be nested, overlaid or discontinuous in the checkride.

(5) Break the exercises into segments and define the conditions which determine the end of each segment. A segment of a checkride is usually any piece of the checkride during which time the desired value and tolerance for monitored parameters is constant. The best example of segment usage is a computer listing for the delivered checkrides. A segment can represent any length of time. Its end conditions can be timed-based, event-based, or a combination of time- and event-based. Segments do not have to monitor anything. They can be used to perform special instructor action such as:

operate the STORE PLOT switch
insert malfunctions
select the gunner scoring display
select a specific ATC comm scenario
select a specific map or GCA display

(6) If there are portions of a checkride where no action is required or no parameters need to be monitored, a dummy segment can be inserted. A dummy segment would consist of a segment number and title. Its effect would be to put the monitoring system into an idle state until the dummy segment end conditions were met (i.e., time) .

(7) After the complete content of the checkride segments have been defined, the data must be prepared for keypunching. Any standard 80-column keypunch form can be used. An example is shown in figure 8-2. Data is entered on the keypunch form adhering to the data format and syntax rules defined by this document. These keypunching forms are then punched up at the model 026 keypunch or equivalent. The deck of cards produced will be the checkride data deck. These forms should be kept on file to assist in any future update of the checkride scenario.

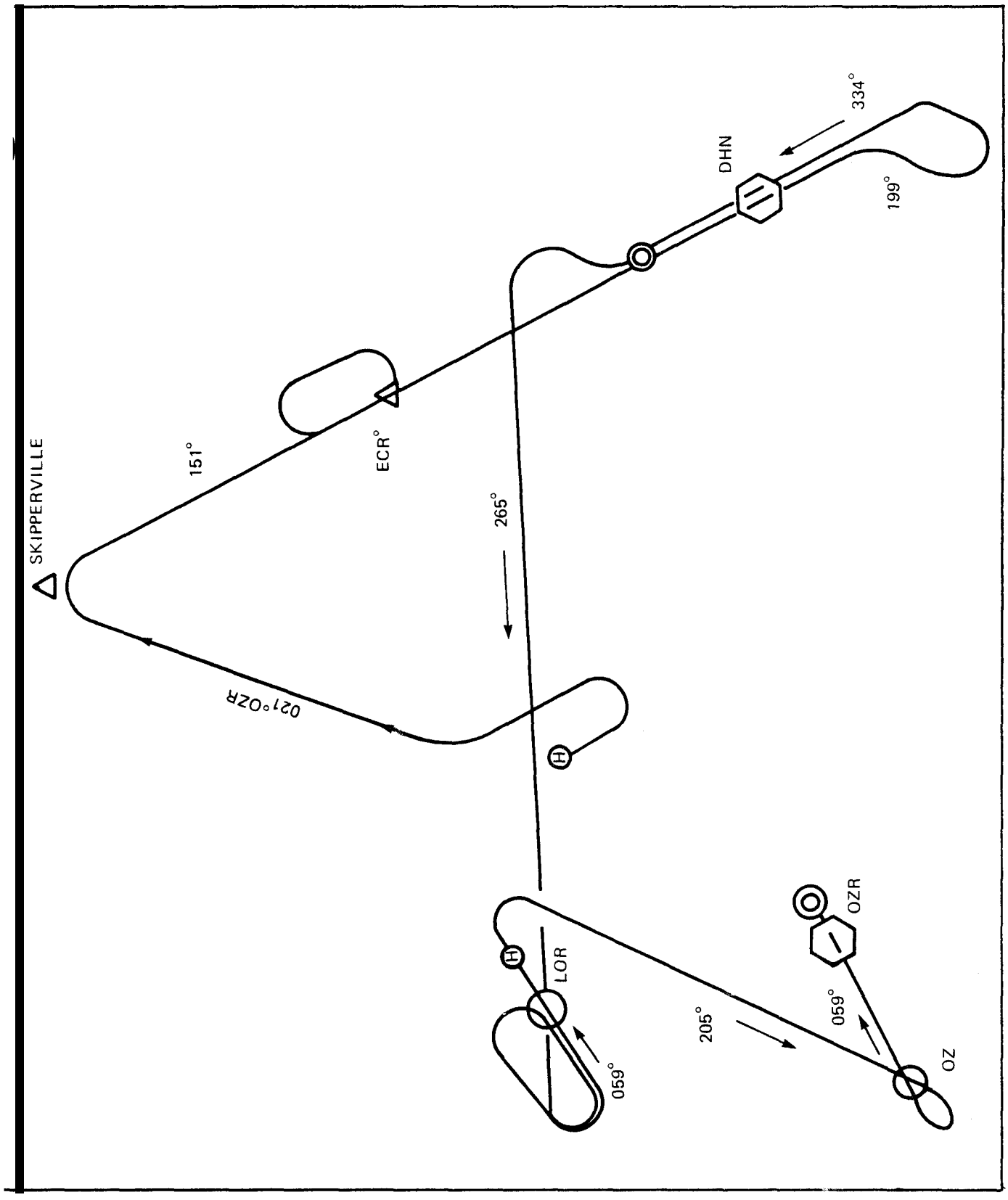


Figure 8-3. Possible Checkride Plan (Rough)

(8) The checkride data deck, once formed, is placed into the applicable job deck (one for VFR and another for WPNS) for checkride problem formulation. This job deck will be identified as CKRIDW (Weapons) or CKRIDV (Visual). See figures 8-4 and 8-5 for the appropriate job deck structure. This job deck is to be run while the simulator is off-line and the computer is in the Batch mode of operation. Upon completion of processing, a newly created checkride will be available for use during the next training session. The printed copy should be checked for syntactical errors that might compromise the effectiveness of the checkride. Refer to figure 8-6, Notes 1, 2 and 3, as an example of error notification.

(9) File Maintenance. The file space required to create a checkride has been allocated with enough reserve to allow for normal expansion of the checkride scenario. The available reserve is approximately 15% of the delivered checkrides.

b. To Revise an Existing Checkride. Whenever a checkride is to be revised in whole or in part the entire checkride data deck must, in the end, be processed. The need for change may be from a variety of reasons. It might be simply because the printed copy of the previous attempt to put together a checkride has shown an error in format which comprises the intent. Another reason would be because during the checkride mode of operation in the simulator the checkride did not "perform" as expected due to incorrect values or missing parameters. Still another reason for rewriting a portion of the checkride might be due to simplification of a set of maneuvers or a more comprehensive one. For whatever the reason, the rules to follow are the same.

(1) Identify the segment(s) in question.

(2) Using the data input sheets (figure 8-2) develop the segment in terms of end conditions and monitored parameters. Be sure to include the segment number appropriately.

NOTE

When adding/deleting a segment, the remainder of the checkride segment numbers must reflect the new segment ordering sequence. The deck of cards produced from these data sheets should now replace those in the original checkride data deck.

(3) This data deck must now be processed in a manner identical to the one described when creating a new checkride.

An example of changing an existing checkride using figure 8-6, Notes 2 and 3:

Segment 14 has been mispunched. Using a blank data sheet (Figure 8-2) rewrite the 1st line as:

014 CLIMB ALT > 2900' IAS 100+-10K CONTINUE CLIMB,

Rewrite the 3rd line as:

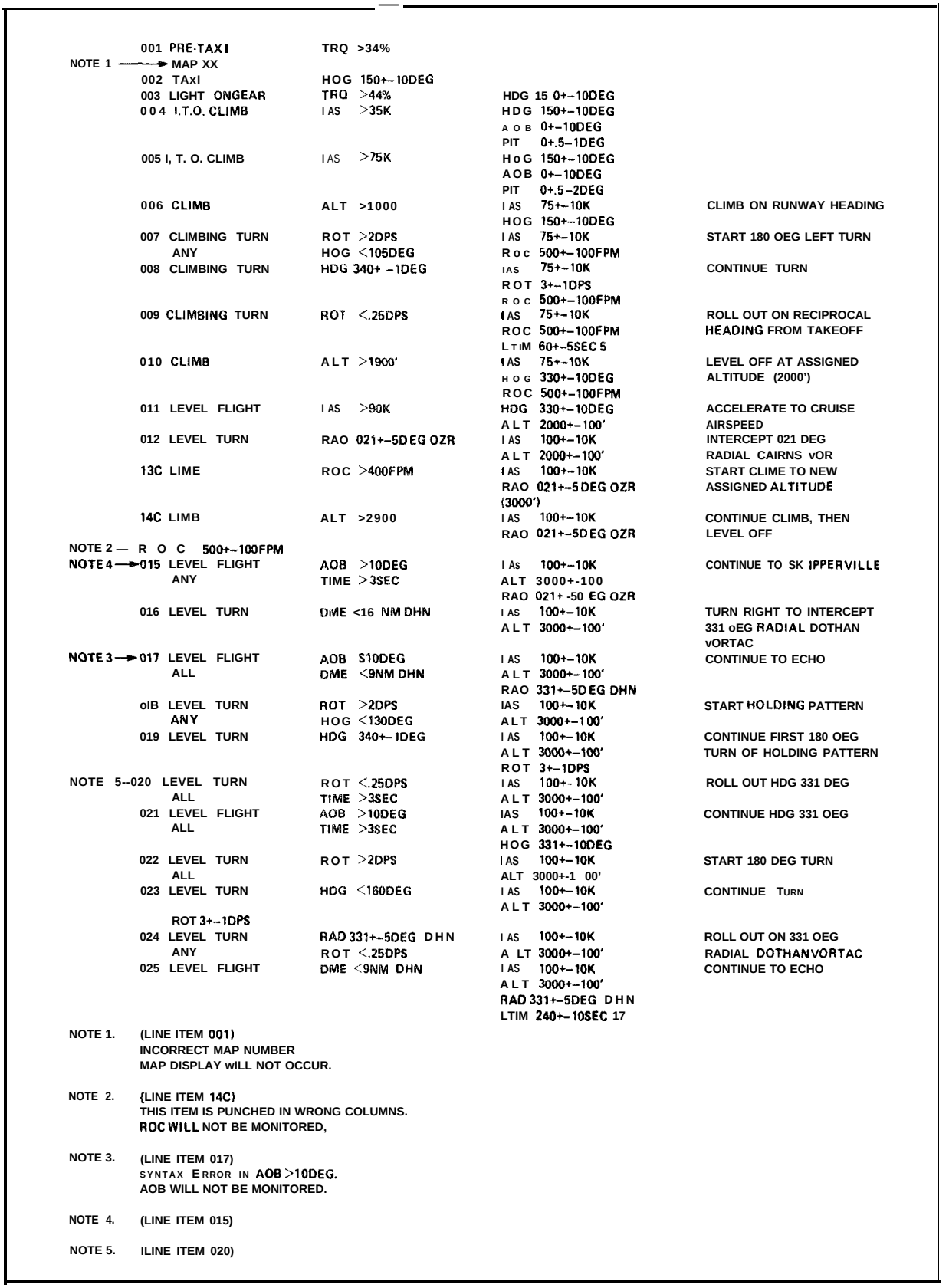
ROC 500+-100 FPM

```
1.  $JOB CKRID ¢16Ø.3!
2.  $RUN PIP
3.  #PFOS.BI < BI:/FA
4.  (PLACE DATA STATEMENT CARDS HERE)
5.  $EOD
6.  #PFOS.CDS/CO < PFOS.BI
7.  $RUN CKRIDE
8.  #YCR214.DIR, YCR212.DIR, YCR2ØØ.DIR   PFOS.CDS, NAVØ4Ø.CIL
9.  $RUN PIP
10. #LP: <PFOS. CDS
11. #PFOS.*/DE
12. $FIN
```

Figure 8-4. VFR Checkride Job Deck

```
$JOB CKRIDW ¢160.3!
$RUN PIP
#PFOS.BI < BI:/FA
(PLACE DATA STATEMENT CARDS HERE)
$EOD
#PFOS.CDS/CO < PFOS.BI
$RUN CKRIDW
#YCR215.DIR, YCR213.DIR, YCR2Ø1.DIR < PFOS.CDS, NAVØ7Ø.CIL
$RUN PIP
#LP: < PFOS. CDS
#PFOS.*/DE
$FIN
```

Figure 8-5. Weapons Checkride Job Deck



```
          001 PRE-TAXI          TRQ >34%
NOTE 1 ---> MAP XX
          002 TAxI              HOG 150+-10DEG
          003 LIGHT ONGEAR      TRQ >44%          HDG 15 0+-10DEG
          004 I.T.O. CLIMB      IAS >35K          HDG 150+-10DEG
                                                  AOB 0+-10DEG
                                                  PIT 0+.5-1DEG
          005 I, T. O. CLIMB    IAS >75K          HoG 150+-10DEG
                                                  AOB 0+-10DEG
                                                  PIT 0+.5-2DEG
          006 CLIMB             ALT >1000         IAS 75+-10K          CLIMB ON RUNWAY HEADING
                                                  HOG 150+-10DEG
          007 CLIMBING TURN     ROT >2DPS         IAS 75+-10K          START 180 OEG LEFT TURN
              ANY               HOG <105DEG       Roc 500+-100FPM
          008 CLIMBING TURN     HDG 340+ -1DEG    IAS 75+-10K          CONTINUE TURN
                                                  ROT 3+-1DPS
                                                  ROC 500+-100FPM
          009 CLIMBING TURN     ROT <.25DPS       IAS 75+-10K          ROLL OUT ON RECIPROCAL
                                                  ROC 500+-100FPM      HEADING FROM TAKEOFF
                                                  LTIM 60+-5SEC 5
          010 CLIMB             ALT >1900'        IAS 75+-10K          LEVEL OFF AT ASSIGNED
                                                  HOG 330+-10DEG       ALTITUDE (2000')
                                                  ROC 500+-100FPM
          011 LEVEL FLIGHT      IAS >90K          HDG 330+-10DEG       ACCELERATE TO CRUISE
                                                  ALT 2000+-100'       AIRSPEED
          012 LEVEL TURN        RAO 021+-5DEG OZR IAS 100+-10K         INTERCEPT 021 DEG
                                                  ALT 2000+-100'       RADIAL CAIRNS vOR
          13C LIME              ROC >400FPM       IAS 100+-10K         START CLIME TO NEW
                                                  RAO 021+-5DEG OZR    ASSIGNED ALTITUDE
                                                  (3000')
          14C LIMB              ALT >2900         IAS 100+-10K         CONTINUE CLIMB, THEN
                                                  RAO 021+-5DEG OZR    LEVEL OFF
NOTE 2 — R O C 500+-100FPM
NOTE 4 ---> 015 LEVEL FLIGHT    AOB >10DEG        IAs 100+-10K         CONTINUE TO SK IPPERVILLE
              ANY               TIME >3SEC        ALT 3000+-100
                                                  RAO 021+ -50 EG OZR
          016 LEVEL TURN        DME <16 NM DHN    IAS 100+-10K         TURN RIGHT TO INTERCEPT
                                                  ALT 3000+-100'       331 oEG RADIAL DOTHAN
                                                                       vORTAC
NOTE 3 ---> 017 LEVEL FLIGHT    AOB S10DEG        IAS 100+-10K         CONTINUE TO ECHO
              ALL               DME <9NM DHN      ALT 3000+-100'
                                                  RAO 331+-5DEG DHN
          oIB LEVEL TURN        ROT >2DPS         IAS 100+-10K         START HOLDING PATTERN
              ANY               HOG <130DEG       ALT 3000+-100'
          019 LEVEL TURN        HDG 340+-1DEG     IAS 100+-10K         CONTINUE FIRST 180 OEG
                                                  ALT 3000+-100'       TURN OF HOLDING PATTERN
                                                  ROT 3+-1DPS
NOTE 5--020 LEVEL TURN          ROT <.25DPS       IAS 100+-10K         ROLL OUT HDG 331 DEG
              ALL               TIME >3SEC        ALT 3000+-100'
          021 LEVEL FLIGHT      AOB >10DEG        IAS 100+-10K         CONTINUE HDG 331 OEG
              ALL               TIME >3SEC        ALT 3000+-100'
                                                  HOG 331+-10DEG
          022 LEVEL TURN        ROT >2DPS         IAS 100+-10K         START 180 DEG TURN
              ALL                                 ALT 3000+-1 00'
          023 LEVEL TURN        HDG <160DEG       IAS 100+-10K         CONTINUE TURN
                                                  ALT 3000+-100'
              ROT 3+-1DPS
          024 LEVEL TURN        RAD 331+-5DEG DHN IAS 100+-10K         ROLL OUT ON 331 OEG
              ANY               ROT <.25DPS       A LT 3000+-100'      RADIAL DOTHANVORTAC
          025 LEVEL FLIGHT      DME <9NM DHN      IAS 100+-10K         CONTINUE TO ECHO
                                                  ALT 3000+-100'
                                                  RAD 331+-5DEG DHN
                                                  LTIM 240+-10SEC 17

NOTE 1.  (LINE ITEM 001)
         INCORRECT MAP NUMBER
         MAP DISPLAY wILL NOT OCCUR.

NOTE 2.  {LINE ITEM 14C)
         THIS ITEM IS PUNCHED IN WRONG COLUMNS.
         ROC WILL NOT BE MONITORED,

NOTE 3.  (LINE ITEM 017)
         SYNTAX ERROR IN AOB >10DEG.
         AOB WILL NOT BE MONITORED.

NOTE 4.  (LINE ITEM 015)

NOTE 5.  ILINE ITEM 020)
```

Figure 8-6. Typical Printed Page of a Checkride

Segment 17 has been mispunched. Using a blank data sheet rewrite the 1st line as:

017 LEVEL FLIGHT AOB > 10DEG IAS 100+-10K CONTINUE

c. Data Format. The checkride data input sheet (figure 8-2) divides the card into five fields:

Field	Columns	Designation
1	1 to 3	Segment Number
2	5 to 16	Title and Special Action
3	18 to 36	Segment End Condition
4	38 to 56	Monitored Parameter
5	56 to 80	Remarks

Field description (figure 8-2) is as follows:

(1) Field 1 - Segment Number: This field is used only to indicate the start of a segment. The valid range of numbers is from 1 to 999 and must be employed in a sequential, ascending order.

(2) Field 2 - Segment Title: This field, when associated with a segment number, may contain a brief text to provide a title for this segment.

(3) Field 2 - Special Action Cue: For other than the first card of a segment, this field may contain a special action cue which basically automates an IOS switch function (see table 8-1). These special action cues are limited to those listed in the table.

(4) Field 3 - Segment End Condition: This field contains a description of the aircraft parameter that, when met, will cause this segment to end, and the next to begin if any. See table 8-2.

(5) Field 4 - Monitored Parameter: This field contains a description of the aircraft parameter that, if exceeded, will be considered as pilot error and will be appropriately reported and recorded for overall evaluation. See table 8-2.

(6) Field 5 - Remarks: This field may be used to provide text in support of the entire segment. This text may be continued on all subsequent. cards of the segment.

(7) Fields 3 and 4 - Syntax: These aircraft parameter fields will, for this description, be divided into two portions: the name and the value/units. The name will be taken from the allowable aircraft parameters listing given in table 8-2. The name will be separated from the value by a single blank column. The value shall be immediately followed (no blanks) by the units symbol. The value may appear in the following ways:

> (±)vu	Greater than
<(±)VU	Less than
(±)V+-TU	Value ± Tolerance (symmetric tolerances)
(+)V+T-TU	Value + Tolerance - Tolerance (asymmetric tolerances)
v-to vu	Value to Value

Table 8-1. Permissible Special Actions Cues Syntax

IAL ACTION CUE	FUNCTION	LIMITS AND CONSTRAINTS
XX	Selects specified Map Display	is limited to 30 to 40*
45	Selects GCA Display	
R XX	Selects Scoring Display	is limited to 47, 48 or 49*, which further limits scoring sequence
F XXX	Inserts the specified Malfunction	is limited to 351 to 899*
XX	Selects specified ATC Com Scenario	is limited to 1 to 127
P X	Operates Store Plot Logic	is limited to 1 or 2 which selects the display buffer: 1 = Page Buffer 2 = Map Buffer
D XXX	Deletes specified Malfunction	is limited to 351 to 899*
E XX	Designates a Moving Tgt from Sequence	is limited to one of the possible 3 target sequences previously selected
G XXX	Moving Target Heading	is limited to 1 to 360 degrees
L XX	Moving Target Velocity	is limited to 0 to 50
R XX, YY	Specifies beginning of an Exercise	is limited to: XX 1 to 9 specifying which exercise number YY 1 to 20 specifying which initial conditions to be employed
XX[,YY[,ZZ]]	Specifies Target Sequence from Scoring	are limited to 1 to 10 if SCOR = 47 11 to 20 if SCOR = 48 21 to 26 if SCOR = 49
T	Signals the entire card contains an extended description or title	
	Segment to End only when all End Conditions are met (default)	
	Advance Target Sequence	
	Segment to End when any End Condition is met	

ese limitations correspond to the IOS Panel thumbwheel select designations

<(+)VU
(+)V+-TU
(+)V+T-TU
V to VU

Less than
Value + Tolerance (symmetric tolerances)
Value + Tolerance - Tolerance (asymmetric tolerances)
Value to Value

Table 8-2. Allowable Aircraft Parameters

Name	Units	Description
ALT	FT or '	PRESSURE ALTITUDE (INDICATED)
AS	KTS	INDICATED AIRSPEED
TIM	SEC	TIME (IN END CONDITION OR SEGMENT TIME)
LTM	SEC S	TIME ELAPSED SINCE PREVIOUS SEGMENT ENDED
TRQ	%	ROTOR TORQUE
GS	KTS	GROUND SPEED
RP	RPM	ROTOR SPEED
EGT	%	EXHAUST GAS TEMPERATURE
Vs	FPM	VERTICAL SPEED
ROT	DPS	RATE OF TURN
DIS	NM xxx	DISTANCE TO ADF FACILITY
DME	NM XXX	DISTANCE TO NAVIGATION FACILITY
GSD	DEG XXXX	GLIDE SLOPE DEVIATION
LOC	DEG XXX	LOCALIZER DEVIATION
CRS	DEG XXX	COURSE TO ADF FACILITY (NAG)
BRG	DEG XXX	BEARING TO ADF FACILITY (NAG)
RAD	DEG XXX	RADIAL FROM NAVIGATION FACILITY (NAG)
HDG	DEG	HEADING (TRUE)
PIT	DEG	PITCH
YAW	BALL WIDTH	YAW (SIDESLIP)
AOB	DEG	ANGLE OF BANK (ROLL)
N1	%	GAS PRODUCER SPEED
RNG	M	RANGE TO TARGET (METERS)
HAG	FT	FIELD ELEVATION
ER	RPM	ENGINE SPEED

NOTE

Above mnemonics can be used for designation of end conditions or monitored parameters.

XXX Radio Station Call letters are required.

S is Segment referenced number.

V + TU	Value + Tolerance - 0
V - T U	Value + o -Tolerance

where: V = Value field; i.e., 123 or 1.23 or 0.123 (w/optional sign)
u = Units designator; i.e., KTS or FT or %, etc.

NOTE

The units field may be separated from the value or tolerance by one or more blanks or may even be absent if the parameter is not facility dependent.

Example of Field Entry Syntax:
ALT > 1700'
HDG 120+-4.5DEG
BRG 334 to 344 DEG OZR

d. Monitoring Elapsed Time Between Segments (LTM). The purpose of LTM is to monitor the pilot in the execution of a maneuver which transcends many segments (i.e., a holding pattern).

NOTE

LTM is not logically applicable as a segment end condition yet it is allowed.

When LTM appears as a parameter in a segment it will be ignored by the checkride program until the end condition is met and the segment ends (figure 8-4, segment 009). At this point the elapsed time since the end of the specified segment is computed and compared to the value and tolerances. Should the computed time fall outside the tolerances, an error is charged against the pilot. This error notice will appear on the hard copy error summary. An example of the use of LTM follows:

009 CLIMBING TURN ROT c .25 DPS AS 75+-10K
LTIM 60+-5SEC

In this example, when segment 9 ends, the elapsed time since the end of segment 5 is measured and must be 55 to 65 seconds or the pilot will be in error (tardy or premature).

e. Monitoring Event Time (TIM). When time appears in a segment as a monitored parameter (Field 4), the only logical application would be for determining when the pilot has too long remained in that segment. An example of this could be "TIM c 15 SEC". In this example the pilot would be allowed to maneuver in that segment for 14 seconds. Past this point he would be in error (tardy) and the checkride program would start accumulating error against the time parameter.

f. Time as an End Condition. When time appears in a segment as an end condition (Field 3), it may be applied in one of two ways. The first would be time since the beginning of the segment, and the second would be the time that one (or more) other "end conditions must remain met. The distinction of which application is to be considered is declared in the special action due field (Field 2) by the occurrence of the key words ANY (Case 1) or ALL (Case 2). For example refer to figure 8-6, note 4:

```
015 LEVEL FLIGHT  AOB > 10DEG
    ANY           TIM > 3SEC
```

That would be an application of Case 1 where either angle of bank or segment elapsed time would cause the segment to end. As a second example, refer to figure 8-6, note 5:

```
021 LEVEL FLIGHT  AOB > 10DEG
    ALL           TIM > 3SEC
```

This would be an application of Case 2 where the angle of bank must be maintained for at least 3 seconds for the segment end.

NOTE

Both examples appear similar except for the special action cue ANY in the first example and ALL in the second example. The segment elapsed time is not a segment limiting factor in the second example as it was in the first.

It should be noted here that the usage of TIM and ALL have a special connotation which varies somewhat from the other usage of ALL vs. multi-end conditions. Refer to figure 8-6, Note 3:

```
017 LEVEL FLIGHT  AOB > 10DEG
    ALL           DME < 9NM DHN
```

In this case, angle of bank and the distance to Dothan create the end condition. They do not have to be met simultaneously. Once one has been met, it is no longer monitored leaving the other to trigger the actual segment end.

g. Checkride Data Deck Restrictions

(1) A checkride shall not exceed 600 cards (1200 for two checkrides).

(2) Any segment shall not exceed 6 cards (program; controlled) .

(3) Any segment must therefore contain not more than 6 end condition parameters and not more than 6 aircraft monitored parameters.

(4) A segment is limited to one occurrence of any particular special action cue.

(5) Special action cues MAP, GCA and SCOR may ***not*** appear in the same segment (the latest entry would be applied).

(6) Special action cues ANY and ALL may not appear in the same segment (the ALL condition would be applied) .

(7) Any number of parameters (Fields 3 & 4) of a segment may be radio facility dependent but the same facility must be referenced throughout that segment.

(8) LTM is restricted to referencing a segment ended not more than 15 seconds prior; i.e., while in the 24th segment, the eldest segment which could be referenced would be 009 (24-15).

h. Error Notification

(1) Error in Field 1: Segments not in sequence. Column 1 = *

(2) Error in Field 2: Unidentifiable action or value outside acceptable limits. Column 4 = ;

(3) Error in Field 3: Unidentifiable parameter, missing value or syntactically incorrect, missing station call letters. column 17 = *

(4) Error in Field 4: Same as for Field 3. Column 32 = *

(5) Error in Card Count: Too many (more than 6) cards in this segment. Column 3 = ! on offending card(s) .

Section II. DEMONSTRATION EDIT AND FORMULATION

8-4. GENERAL. To formulate or edit a demonstration, the objective is: 1) to record on disk a flight or mission profile, as performed by an expert Army aviator; then 2) to edit or record audio commentary on tape which will accompany the recorded performance to be played back as a demonstration to a student pilot in the simulator. This section provides the procedures required to formulate, edit and playback check a demonstration.

8-5. DEMONSTRATION. The computer complex system records on disk all cockpit hardware inputs to the simulation computer as a function of time. For demonstration exercises, sufficient disk space is available to store 240 minutes (4 hours) total of dynamic profile which corresponds to MET.

a. When a RECORD DEMO mode is first selected, a block of initialization data is transferred to disk immediately. Sufficient data is recorded to completely reset the simulator to an arbitrary configuration. Within a single demonstration, nine maneuver marks can be recorded. A block of initialization data is recorded immediately on disk whenever a maneuver mark is inserted.

b. During playback, hardware inputs from the the cockpit to the simulation computer are suspended. These inputs are replaced by disk resident data previously recorded. In playback, the computer controls and repositions throttle, cyclic, collective, and directional controls as they were recorded. The result of switch activation is played back, but switch position is not physically or automatically moved.

c. As a result of computer controlled playback, the simulator reflies the mission. All motions, sounds, instrument indications, and out-the-window scenes are recreated.

d. The simulator can exit a demonstration at any point during the demonstration, and the simulator can be manually flown from that point, or another mode of operation may be selected.

8-6. OPERATIONAL CONSIDERATIONS. The system provides for up to 20 demonstrations with synchronized audio commentary.

a. Each demonstration can be subdivided by up to 9 maneuver marks that provide intermediate entry points to specific maneuvers. An intermediate point can be played back with synchronized commentary once the audio tape is cued to the appropriate start point, or can be played back without audio immediately after replay setup completes.

b. Within one demonstration, therefore, several maneuvers can be presented. These maneuvers can be formulated so that the entire demonstration takes on a mini-mission contiguity or it can be formulated so that no contiguity exists (i.e., the demonstration consists of several unrelated maneuvers).

c. Each demonstration is limited in time to its audio tape length which is approximately 30 minutes. The total system capacity is limited to approximately 240 minutes or 4 hours of accumulated MET. Experience has shown that total mission elapsed time of approximately 20 minutes consumes approximately 30 minutes of wall clock time when the audio is edited over the recorded maneuvers of a demonstration.

Briefings, discussions, and pauses account for the difference in MET and wall clock time. Use of slow-time editing would further decrease the total MET.

d. Demonstrations are made in two parts - first, the aerodynamic maneuvers are recorded, reviewed, and, when found acceptable to the school standard, form the basis for the second operation: editing and recording audio.

NOTE

Audio is limited to 30 minutes per demonstration.

e. Demonstrations once recorded can be rerecorded from the very start or from any intermediate maneuver (i.e., when rerecorded, everything beyond the rerecord entry point must be rerecorded). whenever any part of a demonstration is rerecorded, the entire audio editing for that demonstration must be rerecorded. To minimize this effect, it is suggested that each maneuver be reviewed prior to performing the next phase (maneuver) within any single demonstration. Although this process is time-consuming and frustrating, when a demonstration recording of aerodynamic maneuvers is completed, it will not have to be rerecorded. Audio reediting does not affect maneuvers recording.

f. At the IOS left console, the four switches left of the EDIT AUDIO RECORD switch on the Demo Control panel shown below may be used during formulation (recording aero profile).

Demo Control

RECORD DEMO	**RECORD** MANEW MARK	EDIT MARK/ PAUSE	FRZ ON MANEW MARK	EDIT AUDIO RECORD	EDIT SLOW TIME

g. The RECORD DEMO switch is used in conjunction with the thumbwheel selector and INSERT switch to initiate demo formulation (aero record) . Depression of the illuminated RECORD DEMO switch stops formulation at the print without deletion of the entire previously recorded demonstration (maneuvers) .

h. Since freeze is not recorded during demo formulation, activities performed by the operator at the IOS during freeze, other than insertion of IC, should be curtailed. Do not target advance, insert malfunctions, or edit during demo formulation freeze.

i. The RECORD MANEW MARK function defines the end of one maneuver and the reentry point for the next maneuver. During a recording, depression of this switch marks a reentry point unless FRZ ON MANEW MARK is simultaneously active. In this case, the trainer freezes once the mark is recorded. During a demonstration, only nine RECORD MANEW MARK actions are allowed. When more than nine entries are made, the ninth entry is replaced by the last subsequent entry.

j. The EDIT MARK\PAUSE mark function is used during demo formulation to mark a point where, during playback, demo audio is desired to be inserted without continuing with aerodynamic maneuvers. This is a stop action in playback that allows long commentary to be presented or a prologue to be recorded during audio edit. Any number of edit pause marks may be used during formulation.

NOTE

EDIT MARK/PAUSE must not be entered concurrent with MANEUV MARK . Three seconds of mission elapsed time must separate a MANEW MARK and an EDIT mark.

k. Demonstrations are formulated and edited in integrated mode. They can be played back in either integrated or independent mode. During independent playback, the result of actions not formulated within the playback cockpit cannot be seen. (In pilot independent playback, any weapons fired by the gunner are not seen.)

l. It is important to select a CRT page in both cockpits prior to formulation which, during playback, will give an observer the most useful information. Before formulation of a tactical weapons demo, select appropriate score page, target configuration, and weapons load. Formulate the demo by shooting at aim spot. Before formulation of demonstration of HSS, the HSS alignment in both pilot and gunner cockpits must be accomplished.

m. Before recording a demonstration at segment O, perform DATA CLEAR prior to selection of RECORD DEMO. During demonstration formulation, the following actions are allowed:

(1) Malfunctions can be inserted or deleted.

(2) Targets can be advanced.

(3) IC's can be inserted.

Actions NOT allowed during demonstration formulation and editing are:

(1) No edit functions whatsoever are allowed to any CRT page.

(2) Weapons configuration cannot be changed except by IC insert.

(3) CRT page cannot be changed.

(4) Targets cannot be redesignated.

(5) Demo record in independent mode is not possible.

(6) Formulation or editing cannot proceed until appropriate message appears on both pilot and gunner CRTs.

(7) ICs and maneuver marks cannot be inserted closer than 3 seconds either side of each other.

(8) No activities at IOS are recorded while in manually activated FREEZE except an IC.

(9) EDIT PAUSE and EDIT SLOW TIME cannot be used simultaneously.

(10) EDIT PAUSE and EDIT SLOW TIME cannot be inserted closer than 3 seconds either side of each other, either side of an IC, or either side of a MANEW MARK.

(11) EDIT MARK cannot be inserted closer than 3 seconds either side of an IC or either side of a MANEUV MARK.

8-7. SPECIAL CONSIDERATIONS. The targets to be designated as targets of interest cannot be redesignated within a demonstration. During any demo, only three targets can be selected, at one range, on one score page. DATA CLEAR does not completely clear all data on a score page.

a. If engine RPM audible warning is likely to occur during a demonstration, there are two circumstances when the RPM warning disable switch on the pilot's engine control panel should be kept from returning to the ON position. This can be accomplished with a rubber band or tape strong enough to overpower the spring load of the switch. Do not pull the RPM warning circuit breaker. The first circumstance is during formulation at user's discretion. It is not heard by the user, but the RPM warning will still be present during the demonstration playback. The second circumstance is during audio editing. The RPM warning must be disabled during audio editing to prevent a double playback of the warning sound.

b. During formulation, radios which are on or off, frequencies tuned or detuned, and radio volumes are all recorded. Receiver switch positions on the ICS units are not recorded Although a radio cannot be heard because the receiver switch is off, the radio is played back if the radio was turned on during recording of the demo. Ensure that radio status is determined and switches are set before beginning formulation. During audio editing, always make sure receiver switches on all ICS units in both cockpits are turned off manually.

8-8. DEMONSTRATION FORMULATION PROCEDURE. Perform a dry run of the flight dynamics following proper documented demo description/scenario until the experienced pilot is familiar with the intent of the demo. To record the demonstration to perform the following:

a. Ensure proper system operation and hydraulics available for motion and control loading both cockpits.

b. Ensure that control loading is unlocked and gunner EMERG ELECT PWR switch is ON.

c. Ensure that both simulators are occupied (I0S station and cockpit).

d. Establish intercommunications.

e. Select integrated mode.

f. Establish communication of RADIO OVER RIDE and STUD MON in both cockpits.

g. Turn COMM radios off.

h. Turn NAV radios off.

i. Establish initial conditions for start of demo; initiate data clear.

j. Select appropriate weapons configuration, target select sequence, fuel loading, etc.

k. Leave simulator in freeze.

1. Ensure that correct CRT is displayed in both cockpits. Edit CRT page if required.

m. Depress RECORD DEMO switch on DEMO CONTROL panel.

n. Set thumbwheel to demo being recorded; i.e., 150. Check that MET time is reset to zero.

o. Depress INSERT switch.

p. Do not proceed until PROCEED WITH DEMO RECORD message appears in the edit area on both the pilot and gunner IOS CRT displays. If ENTRY ALREADY EXISTS message appears, a demonstration already exists for that thumbwheel number setting. If the old demonstration is to be erased and another one recorded in its place, depress INSERT switch a second time. The OFF LINE switchlight blinks while the system is preparing to record a demonstration.

q. Alert all personnel that freeze is about to be removed; release PROBLEM FREEZE.

r. From this point on, operator actions can be varied greatly in order to achieve the desired results. Follow steps s. and t. to fly a single maneuver and establish a new set of initial conditions for the second maneuver.

s. Depress FRZ ON MANEUV MARK switch.

t. When the pilot completes the flight portion of this maneuver, depress RECORD MANEUV MARK switch. The system will freeze automatically.

u. Unfreeze and continue record for at least 3 seconds.

v. If the demonstration scenario does not require a new IC, skip to step aa.

w. Freeze simulator.

x. Select desired IC 1-10 on thumbwheel selector.

y. Depress INSERT.

z. Upon conclusion of IC, when FREEZE indicator illuminates steadily, unfreeze to continue with record of next demo maneuver.

aa. Again, the operator actions can be varied to control the situation. Follow step bb. to perform some tricky maneuver that will require a high level of attention from the student when demonstrated and that must be slowed down or stopped entirely to allow the student to follow the action while being coached via prerecorded audio instruction.

bb. When the pilot enters the tricky maneuver, momentarily depress EDIT MARK switch.

cc. Upon completion of maneuver, depress RECORD MANEW MARK. It is advisable to establish a maneuver mark at the end of every demonstration unless nine maneuver marks have already been used. This provides a point for reentry to record additional maneuvers at a later time.

dd. Unfreeze and continue record for at least 3 seconds.

ee. Freeze simulator.

ff. To exit demo record mode, depress RECORD DEMO switch. Demo record mode may also be exited by selecting recorded demonstration on thumbwheels and depressing delete switch.

gg. The flight portion of a demo should be finalized before proceeding to the edit audio phase. If a maneuver is to be reformulated, the original maneuver and all subsequent maneuvers will be lost.

8-9. FORMULATION REVIEW/PLAYBACK. To review aerodynamic flight portion of demonstration previously recorded:

a. Place simulator in integrated mode if gunner actions are a critical part of the demo.

b. Leave simulator in freeze state.

c. Set thumbwheels to demo being reviewed; i.e., 150.

d. Alert pilot (and gunner) that an initial condition is about to occur. Depress INSERT switch.

e. When FREEZE indicator stops blinking, remove problem freeze.

f. The simulator recreates all pilot (and gunner) actions of the initial maneuver. As the maneuver completes, the simulator goes into a problem freeze automatically if the next maneuver begins with an IC. If there is no IC, skip to step i.

g. The second set of initial conditions should be established in the system automatically.

h. The demonstration automatically unfreezes when IC initialization is complete.

i. Repeat step b. if there are additional maneuvers.

j. The simulator drops out of the demo replay mode automatically. Additional information for demonstration playbacks appears in the next paragraph.

k. At this point, the operator can select to replay the demo again in its entirety or from the last maneuver (i.e. , 151) or, if an error in flight was discovered, the operator can choose to rerecord the demo beginning with the maneuver number that contained the error. When the demo is flown as intended, record the audio (edit) .

8-10. AUDIO EDITING. Once the aerodynamic flight portion of a demonstration is complete, audio editing then takes place.

a. Ensure that the aerodynamic performance of the formulation is complete and meets the criteria of the school. Play back the entire demonstration several times and review the relationship of the script and mission elapsed time (MET). Enter playback at each maneuver mark and record the MET of each. Note on the script the start of each epilogue and annotate MET for the start of each at least 3 seconds before a maneuver mark. Details of when pauses are required and when slow edit is desired should be noted on the script (MET). Once a smooth delivery has been perfected, an audio recording can be undertaken.

b. Prior to editing audio for a demonstration, disable the seat shaker and motion system in both cockpits. Turn off all receiver switches on all ICS units in both cockpits. Disconnect all unused helmets and headsets in both cockpits. The EDIT AUDIO RECORD switch is used in conjunction with the thumbwheel selector and insert controls to initiate the demo edit mode. Depression of the illuminated EDIT AUDIO RECORD switch deletes the demo edit mode. During the demo edit mode, the sound level is automatically set to 0 to permit better audio recording. This zero sound level is not recorded as part of the final demonstration. Hopefully, the one edit session will produce an acceptable commentary for the previously recorded aero demonstration.

c. Experience shows that editing part of an audio tape is almost impossible. Rerecording from a maneuver mark is extremely difficult. This is due to the fact that, on rerecord, the original audio is not totally erased. During periods of desired silence, low-level background audio may be present.

d. During audio edit, two people are required in the pilot cockpit, one to speak the words, the second to cue the speaker and perform edit functions at the IOS. A set of communication hand signs should be developed so that non-verbal directions can be transmitted while voice recording continues. Speak only while the trainer is in FREEZE (not PAUSE mode). In addition, a third person is required at the audio recorder cabinet to cue up tapes, set and check modulation levels, and monitor recorder operation. When FRZ ON MANEUV MARK switch is illuminated, the simulator freezes automatically whenever a previously recorded maneuver mark is encountered.

e. There is no real limit to the number of edit marks on a demo being formulated. These marks, temporary by nature of their function, cause the simulator to automatically freeze when encountered in the edit audio record mode. The purpose of these freezes is to give the operator the opportunity to activate the EDIT SLOW TIME and EDIT PAUSE functions while the simulator is in a total freeze. Until the edit mode is selected, EDIT PAUSE, FRZ ON MANEUV MARK, and EDIT SLOW TIME are inactive. The EDIT SLOW TIME and EDIT PAUSE functions may be evoked a maximum of 20 times during a single demonstration.

f. Under no circumstances should SLOW TIME or PAUSE straddle a maneuver mark. Therefore, at initiation of PAUSE or SLOW TIME, MET should be at least 3 seconds away from maneuver mark. EDIT PAUSE, when selected, allows record of audio while aerodynamics remains frozen; i.e., stop action. Depression of the illuminated

EDIT PAUSE allows resumption of audio recording in synchronization with dynamic playback. It is suggested that freeze be active prior to selection of PAUSE.

g. Selection of EDIT SLOW TIME specifies playback of the aerodynamics in slow time (half speed). This allows commentary during a speedy maneuver to be made more comfortably without resorting to stop action. Depression of the illuminated EDIT SLOW TIME returns the simulator to normal action speed. It is suggested that the simulator be frozen prior to activation of slow time.

NOTE

Slow time and pause are mutually exclusive.

h. Synchronization of audio relies on data being recorded on disk as well as on audio tape. After a demonstration has been found totally acceptable, a backup of the disk should be made.

i. The following example is similar to the demonstration recorded in paragraph 8-8. Perform the following to edit into the flight perfected demonstration a series of programmed freezes and slow-times with continuous audio:

(1) Place simulator in integrated mode.

(2) Disconnect all unused helmets and headsets in both cockpits.

(3) Turn off all receiver switches on ICS units in both cockpits.

(4) Experience has shown it best to record audio from the pilot student location, set pilot ICS transmit-interphone selector switch to hot mike. Set gunner ICS transmit-interphone selector switch to 4. Set both observer ICS transmit-interphone selector switches to 1.

(5) Deselect all communication switchlights at both IOS.

(6) Place 2-minute cartridge in pilot dynamic recorder No. 1. (It is assumed cued up to start of tape.)

(7) Depress EDIT AUDIO RECORD switch.

(8) Set thumbwheels to demo being edited; i.e., 150.

(9) Alert pilot and gunner that an initial condition is about to occur. Depress INSERT switch.

NOTE

A cassette has two spools and is 3-15/16 x 2-1/2 x 5/16-inches.
A type A cartridge has one spool and is 4 x 5-1/8 x 7/8-inches.
A type B cartridge has one spool and is 6 x 7 x 7/8-inches.
Only type B cartridges are *used* on this system.

(10) When FREEZE indicator stops blinking:

(a) Actuate FRZ ON MANEUV MARK switch.

(b) Check that RADIO OVERRIDE and STUDENT MONITOR have been automatically selected by demonstration.

(c) Activate EDIT PAUSE switch if a prebriefing is to be given; otherwise, skip to step (13). and continue with audio recording during aerodynamics.

(11) Begin demo briefing message from any station, speaking into headset.

(12) At end of message delivery, depress EDIT PAUSE switch (off). Problem freeze is removed by deletion of EDIT PAUSE. Continue with step (14).

(13) Remove problem freeze.

(14) The simulator recreates all pilot and gunner actions of the initial maneuver. If a post maneuver message is to be given without aerodynamics, it must occur at least 3 seconds before the MET of the maneuver mark which should have been noted on the script. A post maneuver message could go here if desired by depressing EDIT PAUSE switch and repeating steps (11) and (12). As the maneuver completes, the simulator goes into a problem freeze automatically. FRZ ON MANEWER MARK is an indication by the system to let the operator know that no crucial actions were allowed to be recorded too close to the maneuver mark. During this freeze state, no audio is recorded and the actions to be taken during the next maneuver can be discussed.

(15) Remove problem freeze. Simulator assumes second set of initial conditions automatically after 3 seconds have elapsed. When the set of initial conditions has been completed, problem freeze is removed automatically by the demonstration. Wait 3 seconds after removing problem freeze; then if a pre-maneuver message is required, depress EDIT PAUSE and repeat steps (11) and (12). In either case, then continue with step (16).

(16) The simulator recreates all pilot and gunner actions of the second maneuver. When the playback comes to the point where, during demo record, the EDIT MARK switch was depressed, the simulator goes into problem freeze automatically.

(17) Actuate EDIT SLOW TIME switch.

(18) Remove problem FREEZE.

(19) Resume aural description of the tricky maneuver while the simulator recreates it in slow (half) time.

(20) At conclusion of this difficult maneuver, release EDIT SLOW TIME switch at least 3 seconds prior to the MET of the maneuver mark noted in the script. If a post-maneuver message is desired using EDIT PAUSE, EDIT SLOW TIME must be released at least 6 seconds prior to maneuver mark MET. This permits EDIT PAUSE to be inserted 3 seconds before the maneuver mark and 3 seconds after deletion of slow time.

(21) At the end of the second maneuver, the simulator goes into problem freeze at the next and last maneuver mark.

(22) Remove problem freeze. The simulator drops out of the demo replay mode automatically at the end of the demonstration.

(23) Remove demo cassette from the pilot dynamic recorder and place it in the appropriate position in the demo playback audio cabinet unit 5. After the tape is cued up, it is ready for use in demonstration playback.

8-11. DEMONSTRATION PLAYBACK CHECK. To playback a demonstration perform the following:

a. Attain either independent or integrated mode as desired.

b. Set thumbwheels to demo/maneuver of concern; i.e., 151.

c. The gunner student or instructor/operator can call a flight demo in independent mode for the purpose of having an autopilot (the flight portion of the demo) enabling him to manually control and use his weapons. This differs from a normal demonstration where the weapons would be controlled by the demo playback. The AUTO FLIGHT switch at the gunners IOS allows for this feature.

d. Alert pilot/gunner that an initial condition is about to occur. Depress thumbwheel INSERT switch.

e. The edit area on the IOS CRT shows at various times the status of the audio tape system with messages like:

AUDIO NOT READY: GOING TO PROPER MANEUVER
AUDIO NOT READY: REWINDING
AUDIO NOT READY: IN USE
AUDIO READY

f. At other times, this edit area will be informative as to the status of the procedure being attempted by the operator, with messages like:

ENTRY ALREADY EXISTS
NO SUCH ENTRY EXISTS
WAIT FOR PROCEED
PROCEED WITH DEMO RECORD
DEMO REPLAY ACTIVE

g. When FREEZE indicator stops blinking, remove problem freeze. If an AUDIO NOT READY message is in the edit area when problem freeze is removed, no audio will be heard.

h. The simulator recreates all actions of the demo, beginning at the selected maneuver. As the demo progresses, the briefing message is heard over the headsets; slow times and initial condition inserts are automatic.

i. A demo replay may be terminated by the operator by activating the demo thumbwheel DELETE switch.

j. When the demo plays to completion, the simulator freezes and drops out of the demo replay mode automatically.

CHAPTER 9

EMERGENCY PROCEDURES AND SAFETY

Section I. EMERGENCY PROCEDURES

NOTE

This section contains procedures to be used during an actual simulator malfunction or failure. Procedures for use during simulated malfunctions are contained in chapter 7, paragraph 7-33.

9-1. EMERGENCY SHUTDOWN. Switches are provided throughout the complex for emergency shutdown of the complete simulator system, motion system only, or simulator system excluding the visual. Emergency shutdown can be accomplished at the following locations:

a. Complete Simulator Complex. Switches at these locations shut down the entire simulator complex including the visual system:

Tower assembly areas - Visual System - EMER STOp
Gantry cabinets - Visual System - EMER STOP
Visual linkage cabinets - EMER STOP
Correlator cabinets - EMER STOP

b. Motion System Only. MOTION OFF switches shut down only the associated (pilot or gunner) motion system.

IOS simulator control panels - MOTION OFF
Student control panels - MOTION OFF
Motion cabinets - MOTION OFF

c. Complex Excluding Visual. Switches at these locations shut down the simulator complex excluding the visual system:

Adjacent to IOS left console - EMER STOP
Student control panels - EMER STOP
Digital linkage cabinet - EMER STOP
Analog linkage cabinet - EMER STOP
Motion cabinets - EMER STOP
Motion pumps - EMER STOP
Power cabinet - EMER STOP

9-2. SYSTEM FAILURES. Should a failure be detected, use intercom to contact the computer room and request maintenance. If the system failure can not be cleared within 15 minutes, exit simulator. System failures can occur due to several sources:

Electronic failure
Hydraulic failure
Mechanical failure
Operator induced failure

wARNING

Care should be exercised when exiting the simulator during power failure. The boarding ramp may fail to deploy.

9-3. FACILITY POWER FAILURE. Loss of facility power results in shutdown of the entire device. The following systems become deactivated:

Cockpit illumination (Emergency light unit should activate)
Intercommunication
Motion
Flight control

Section II. SAFETY

9-4. OPERATIONAL SAFETY. The FWS is designed for safe operation during all phases of training.

WARNING

Prior to the activation of motion, all occupants of the simulated cockpit and IOS (limited to three persons per flight compartment) are required to fasten seat belts.

a. Each motion system employs numerous devices to ensure safe operation for personnel. Among these are controlled deceleration devices, cushion stops, limit sensing, leveling and locking devices, thermal cutout for hydraulic fluid, emergency stop switches, and red warning lights in personnel areas.

b. The entrance doors are equipped with safety interlocks that prevent motion activation until the door is secure.

c. The motion equipment is located within a gated area with gate interlocks that prevent motion activation unless the gates are closed.

d. The boarding ramps are equipped with sensing switches to prevent boarding ramp motion with additional weight (person) on the ramp. The motion system is not activated until the boarding ramp is completely raised.

e. Normal activation and deactivation of each motion system is accomplished at the respective IOS. Motion for each flight compartment is controlled separately and is not mode-dependent.

f. Fail-safe circuitry prevents erratic movement of the motion system when equipment malfunctions.

g. Temperature sensors are located in each equipment cabinet. If the temperature reaches 100 degrees Fahrenheit or if adequate airflow is not maintained, visual and aural warnings activate in the computer room. At 110 degrees Fahrenheit, the entire complex automatically shuts down.

h. Actuation of any EMERGENCY STOP switchlight results in the immediate shutdown of the entire complex and motion system. Once an EMERGENCY STOP switchlight has been actuated and the power shuts down, the main and linkage circuit breakers must be manually reset before power can be reapplied.

i. In the emergency stop condition, a quick-settle control valve returns the motion platform to the settled position at the highest practical speed. The boarding ramp lowers under power of a reserve stored energy source. Personnel can safely egress to the access balcony in approximately 24 to 31 seconds, depending on the position of the motion platform at the time electrical power was cut off.

j. An emergency escape ladder is provided should power failure or hydraulic failure prevent a boarding ramp from deployment.

WARNING

Do not discharge a CO_2 fire extinguisher in the confined cockpit.

k. Six fire extinguishers of the CO_2 type are located in central areas of the simulator complex. One in the visual room, one in the computer room, two in the simulator room, and one in each pump room. Two other CO_2 type extinguishers are located in the flight simulator compartments, forming a part of the normal AH-1S cockpit equipment.

1. The visual area is equipped with an intricate series of safety interlock devices, identification signs, and warning lights. A safety system is also provided to prevent physical probe contact with the model board.

GLOSSARY

A

A/C	Aircraft
ACQ	Acquire
ADF	Automatic Direction Finder
ADI	Attitude Direction Indicator
ADJ	Adjust
ADS	Air Data Subsystem
ADS	Airspeed and Direction Sensor
AGL	Above Ground Level
ALT	Airborne Laser Tracker
ALT	Altitude
ANT	Antenna
AP	Attack Point
APU	Auxiliary Power Unit
AR	As Required
ARM	Armed
ASSY	Assembly
ATC	Air Traffic Controller
AUTO	Automatic
AVAIL	Available
AVIM	Aviation Intermediate Maintenance
AVUM	Aviation Unit Maintenance
AZ	Azimuth

B

BAT	Battery
BFO	Beat Frequency Oscillator
BRG PTR	Bearing Pointer
BRT	Bright
BTU	British Thermal Unit

C

C	Celsius, Common
CARR	Carrier
CAS	Calibrated Airspeed
CB	Circuit Breaker
CCW	Counterclockwise
CG	Center of Gravity
CHAN	Channe 1
CKPT	Cockpit
CL	Centerline, Control Loading
CLA	Confined Landing Area
CLLT	Closed-Loop Linkage Test
CMS	Camera Model (Visual) System
COMM	Communication
COMPTR, COMP	Computer
CONFIG	Configuration
CONT	Control, Continuous
CPU	Central Processor Unit

C - continued

CRT	Cathode-Ray Tube
CW	Clockwise
CYL	Cylinder

D

DECR	Decrease
DELTA	Incremental Change
DEPR	Depression
DG	Directional Gyro
DRED	Daily Readiness Test
DSCRM	Discriminator

E

ECS	Environmental Control System
EIA	Electronic Interface Assembly
EL	Elevation
EMER	Emergency

F

F	Fahrenheit, Increment of Equivalent Flat Plate Drag Area
FAT	Free Air Temperature
FCC	Fire Control Computer
FFAR	Folding Fin Aerial Rocket
FLT	Flight
FM	Frequency Modulation
FOD	Foreign Object Damage
FOV	Field-of-View
FPS	Feet Per Second
FRL	Fuselage Reference Line
FT	Foot
FT/MIN	Feet Per Minute
FWD	Forward
FWS	Flight Weapons Simulator

G

GACP	Gunner Accuracy Control Panel
GAL	Gallon
GAL/HR	Gallon Per Hour
GCA	Ground-Controlled Approach
GD	Guard
GHS	Gunner Helmet Sight
GND	Ground
GNR	Gunner
GRWT	Gross Weight
GS	GlidesCope
GYRO	Gyroscope

H

HDG	Heading
HI/LO MAG SWT	Hi/Lo Magnification Switch
HIGE	Hover in Ground Effect
HP	Horsepower
HR	Hour
HS	Helmet Sight
HSI	Horizontal Situation Indicator
HSS	Helmet Sight Subsystem
Hsu	Helmet Sight Subsystem
HTR	Heater
HUD	Head-Up Display
HYDR	Hydraulic
HZ	Hertz

I

IAS	Indicated Airspeed
IC	Initial Conditions
ICDU	Integrated Control and Display unit
ICE	In Ground Effect
ICS	Intercommunication System
IFF	Identification Friend or Foe
IFR	Instrument Flight Rules
IG	Image Generator
ILS	Instrument Landing System
IN.	Inch
INBD	Inboard
INCR	Increase
IND	Indication
IN. HG	Inches of Mercury
INV	Inverter
INOP	Inoperative
INTLK	Interlock
IOS	Instructor/Operator Station
IR	Infrared
IRCM	Infrared Countermeasure
IU	Interface unit

J

JTSN	Jettison

K

KCAS	Knots Calibrated Airspeed
KHz	Kilohertz
KIAS	Knots Indicated Airspeed
KM	Kilometer
KN	Knots
KTAS	Knots True Airspeed
kVA	Kilovolt-Ampere

L

LAI	Low Airspeed Indicator
LB	Pounds
LB/HR	Pounds Per Hour
LHG	Left Hand Grip
LIG	Laser Image Generator
LIM	Limit
LKD	Locked
LOC	Localizer
LOS	Line of Sight
LPN	Link Part Number
LS IG	Laser Image Generator
LTG	Lights

M

M	Modernized Cobra
MAG	Magnetic
MAINT	Maintenance
MALF	Malfunction
MAN	Manua 1
MAx	Maximum
ME	Marker Beacon
MET	Mission Elapsed Time
MFD	Multifunction Display
MHF	Medium-High Frequency
MHz	Megahertz
MIC	Microphone
MIN	Minimum
MM	Millimeter
MOD	Modified
MS I	Missile Status Indicator
MSL	Missile
M&T	Maintenance and Test
MTR	Motor
MUX	Multiplexer

NA	Not Applicable
NAV	Navigator
NM	Nautical Mile
NO	Number
NOE	Nap-of-the-Ear th
NORM	Normal
NVG	Night Vision Goggles
NG	Gas Turbine Speed
NP	Power Turbine

O

OAT	Outside Air Temperature
OBST HT	Obstacle Height
OFT	Operational Flight Trainer
OGE	Out of Ground Effect
OUTBD	Outboard
OVRD	Override

P

PACP	Pilot Armament Control Panel
PAR	Precision Approach Radar
PCB	Printed Circuit Board
PFOS	Problem Formulation Operating System
PHS	Pilot Helmet Sight
PLT	Pilot
PLT ORIDE	Pilot Override
PMT	Photomultiplier Tube
PREM	Preliminary
PRESS	Pressure
PROG	Program, Progress
PSI	Pounds Per Square Inch, Pilot Steering Indicator
PVT	Private
PWR	Power
% Q	Percent Torque

Q

QTY	Quantity

R

R/C	Rate of Climb
RCVR	Receiver
R/D	Rate of Descent
RDS	Rounds
RDS RMNG	Rounds Remaining Indicator
REF	Reference
RKT	Rocket
RMI	Radio Magnetic Indicator
RND REM	Rounds Remaining Indicator
RPM	Revolutions Per Minute
RMS	Rocket Management Subsystem
RTCL	Reticle

S

SAS	Stability Augmentation System
SCAS	Stability and Control Augmentation System
SEC	Second
SECU	Servo Electronic Control Unit
SEL	Select
SHC	Sight Hand Control
SIF	Selected Identification Features
SNG	Single Fire Mode
SPEC	Specification
SQ	Squelch
S/T/A	Stow, Track, Acquisition Switch
STA	Station
STBY	Standby
SW	Switch
SQ FT	Square Feet

T

TAS	True Airspeed
TCP	TOW Control Panel
TEMP	Temperature
TEP	Target Engagement Point
TGT	Turbine Gas Temperature
TML	TOW Missile Launcher
TMS	TOW Missile System
TOI	Target of Interest
TOW	Tube-Launched, Optically Tracked, Wire Command Link
T/R	Transmit-Receive
TRK	Track
TRQ	Torque
TRU	Transformer Rectifier Unit
TSU	Telescopic Sight Unit
TUR	Turret

U

UHF	Ultra-High Frequency
UTIL	utility

V

VAc	Volts, Alternating Current
VCA	Voltage-Controlled Attenuator
Vco	Voltage-Controlled Attenuator
VDc	Volts, Direct Current
VFO	Variable-Frequency Oscillator
VFR	Visual Flight Rules
VHF	Very High Frequency
VIGV	Variable Inlet Guide Vane
VOL	Volume
VOR	Visual Omni Range
VNE	Velocity, Never Exceed (Airspeed Limitation)
VS I	Vertical Speed Indicator
VV	Vertical Velocity

W

WAFS	Wing Arm Fire Switch
WBOA	Wideband Operational Amplifier
WEG	Weapon Effects Generator
WG	Gross Weight
WG STA	Wing Station
WLc	Weapon Loading Configuration
WPN	Weapon
WPN CNFG	Weapon Configuration

XMSN	Transmission
XMTR	Transmitter
XPDR	Transponder

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6	2-a		
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125	Line 20		

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

In line 6 of paragraph 2-1a the manual states the engine has 6 Cylenders. The engine on my set only has 4 Cylenders. Change the manual to show 4 Cylenders.

Callout 16 on figure 4-3 is pointing at a bolt. In key to figure 4-3, item 16 is called a shim - Please Correct one or the Other.

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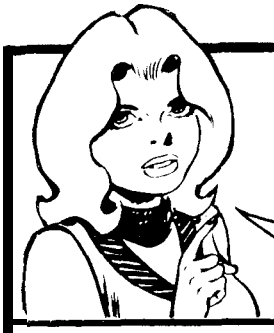

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 deksmeters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grabs
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrarns = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C