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PRELIMINARY SPECIFICATION

FOR

F/A-18 HOTAS PART TASK TRAINER

92-13671



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ENGINEERING AND ECONOMICS RESEARCH, INC.

1593 Spring Hill Road, Vienna Virginia 22180 (703) 847-5750

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SYSTEMS

PRELIMINARY SPECIFICATION
FOR
F/A-18 HOTAS PART TASK TRAINER

May 1989

Prepared By:

EER Systems
3290 Progress Drive
Orlando, FL 32816

Prepared For:

Naval Training Systems Center
12350 Research Parkway
Orlando, FL 32826

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PRELIMINARY SPECIFICATION
FOR
F/A-18 HOTAS PART TASK TRAINER

MAY 1989

NAVAL TRAINING SYSTEMS CENTER
12350 RESEARCH PARKWAY
ORLANDO, FL 32826

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PRELIMINARY SPECIFICATION FOR
F/A-18 HOTAS PART TASK TRAINER

1.0 SCOPE

1.1 Specification Scope. This specification covers the requirements for the design and construction of a deployable F/A-18 HOTAS Part-Task Trainer. This device shall simulate, to a limited degree as specified herein the crew station of the single place, dual engine F/A-18 aircraft. The device shall consist of a trainee station simulating the F/A-18 cockpit and a visual system display, a trainer operation console (CRT terminal) and a mini computer system.

1.2 Purpose of the Device. The F/A-18 HOTAS Part-Task Trainer will be utilized aboard a carrier to train Navy/Marine Corps pilots to maintain proficiency in those skills and techniques involved in using the HOTAS system in operation of the F/A-18 aircraft. The trainer shall provide training in air-to-air target intercepts and weapon delivery, air-to-ground weapon delivery, High Speed Anti-Radiation Missile (HARM) system operation, radar operation, FLIR operation, radar warning system operation, and Electronic Countermeasures (ECM) operation.

1.3 Classification. This specification covers a deployable trainer intended for installation aboard a carrier.

2.0 APPLICABLE DOCUMENTS

2.1 Document List. The following documents of the issue in effect on the date of invitation for bid or request for proposal form a part of this specification to the extent specified herein.

SPECIFICATIONS

Military

MIL-B-5087	Bonding, Electrical, and Lighting Protection for Aerospace Systems
MIL-T-2399IE	Training Device, Military, General Specification for
MIL-H-46855B	Human Engineering Requirements for Military Systems, Equipments, and Facilities
MIL-F-29046	Flooring, Raised, General Specification for
MIL-I-82356	Instruments, Simulated, for Aircraft Training Device; General Specification for, including Amendments through MIL-I-82356/27

STANDARDS

Federal

FED-STD-595	Colors
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Military

MIL-STD-454H	Standard General Requirements for Electronic Equipment
MIL-STD-461B	Electronic Emission and Susceptibility Requirements for Control of Electromagnetic Interference
MIL-STD-1310D	Shipboard Bonding, Grounding, and other techniques for Electromagnetic Compatibility and Safety
MIL-STD-1472C	Human Engineering Design Criteria for Military System, Equipment, and Facilities
MIL-STD-1644B	Trainer System Software Engineering Requirements

PUBLICATIONS

Naval Air System Command

NAVAIR A1-F18AC-NFM-000, NATOPS Flight Manual, Navy Model FA-18A/B.

NAVAIR A1-F18AC-TAC-000, F/A-18 Tactical Manual, Vol. I
(Confidential)

NAVAIR A1-F18AC-TAC-010, F/A-18 Tactical Manual, Vol. II
(Confidential)

NAVAIR A1-F18AC-TAC-100, F/A-18 Tactical Manual, Vol. III
(Secret)

McDonnell Aircraft Company

MDC B0528, Operation of the F/A-18 Avionic Subsystem for F/A-18C/D Aircraft with 87X-OFPS.

(Copies of specifications, standards, publications, and drawings required by suppliers in connection with specific procurement functions may be obtained from the procuring activity or as directed by the Procuring Contracting Officer (PCO)).

3.0 REQUIREMENTS

3.1 System Design. The F/A-18 HOTAS Part-Task trainer shall provide refresher training in the maintenance of pilot HOTAS skills and techniques to efficiently operate the F/A-18 aircraft in an operational environment. The device shall consist of a trainee station simulating the F/A-18 cockpit to the degree necessary to accomplish the training objectives; a visual display system, a trainee operator station; and a general purpose digital computation system for simulator activation. The trainee station shall be capable of independent operation by the trainee without the presence of an Instructor or Operator. The trainer shall simulate to the extent specified herein the HOTAS and associated equipments

installed in the F/A-18 aircraft. Simulations shall include the following:

- (a) HOTAS system operation
- (b) Air-to-Air offensive and defensive operations
- (c) Air-to-Ground offensive and defensive operations
- (d) Air-to-Air radar operation
- (e) Air-to-Ground radar operation
- (f) FLIR operation
- (g) Air-to-Air weapon delivery
- (h) Air-to-Ground weapon delivery
- (i) HARM delivery
- (j) ECCM/ECM system operation

3.1.1 Description of the Training Environment. The environment to be simulated shall be comprised of land, water and surrounding airspace, shall include a single F/A-18 aircraft in addition to ownship, threat aircraft, and related visual objects. The tactical environment shall include both fixed and mobile threat emitters for appropriate land based, shipborne or airborne threats. Simulation under day, dusk and night conditions shall be provided. The training environment shall provide the necessary visual cues to accomplish the required training objectives.

3.1.1.1 Training Objectives. The F/A-18 HOTAS Part-Task Trainer shall be designed to satisfy training for the following training objectives:

(a). Air-to-Air Mode

- (1) Set up cockpit for air-to-air mode
- (2) Perform missile/gun checks
- (3) Perform Stores Display, HUD, and radar display interpretation
- (4) Select radar mode
- (5) Set up ECM equipment

- (6) Perform target search
- (7) Perform target detection and acquisition
- (8) Perform target intercepts
- (9) Select air-to-air tactics
- (10) Launch AIM-7 missile
- (11) Launch AIM-9 missile
- (12) Perform gun attack

(b). Air-to-Ground Mode

- (1) Set up cockpit for Air-to-Ground mode
- (2) Check weapon status
- (3) Set up ECM equipment
- (4) Perform visual/radar navigation
- (5) Perform FLIR tactics
- (6) Perform interpretation of radar, HUD, FLIR and stores displays
- (7) Perform target designation and cursor manipulation
- (8) Perform weapon and release option selection
- (9) Program weapons entry
- (10) Set up HARM for launch
- (11) Perform HARM launch
- (12) Perform gun strafing

(c). Defensive Tactics

- (1) Set up ECM/ECCM equipment
- (2) Interpret radar warning receiver threats
- (3) Perform identification of air-to-air threats
- (4) Perform identification of air-to-ground threats
- (5) Perform RF jamming
- (6) Perform counter to air-to-air threats
- (7) Perform counter to air-to-ground threats
- (8) Perform ECM and ECCM

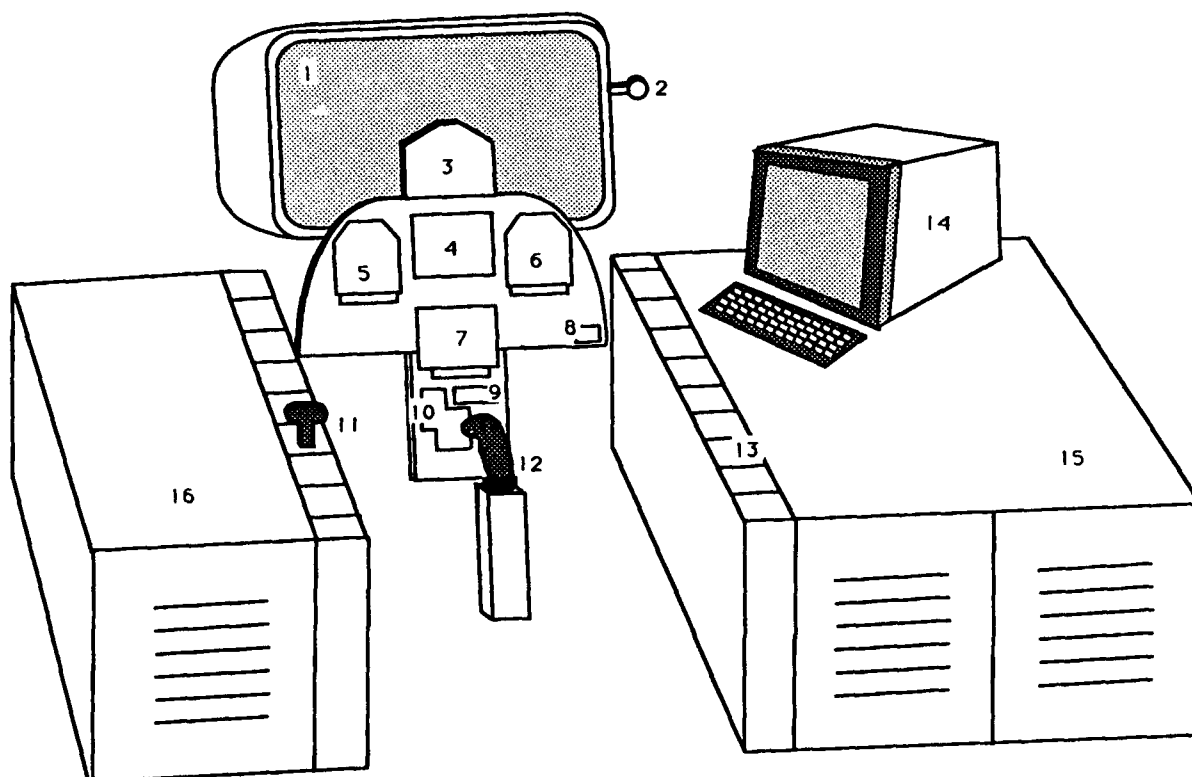
3.2 Device Description. The trainer shall provide part-task training in the utilization of the HOTAS system of the F/A-18 aircraft in an operational environment. Only those controls, indicators, displays, systems, and conditions and situations pertinent to the training objectives shall be simulated. The trainer shall consist of a trainee station, comprised of a center bay and two side consoles, a visual system mounted in front of the center instrument panel, a computer system located next to the right side console, and a trainer operation console located adjacent to the center instrument panel. Figure 1 presents a conceptual representation of the trainer.

3.2.1 Trainee Station. The trainee station shall provide the relative geometry and position of the F/A-18 cockpit components but exact reproduction of the cockpit is not required. The center bay provides for the center instrument panel and the flight control stick; the left console provides for the throttle quadrant and throttles; and the right console provides for the sensor control panel. Only those controls, indicators and displays required to accomplish the training objectives shall be functional and operate in the same manner as in the aircraft. All other controls, indicators and displays not required for training shall be non-functional and shall be photographically represented. The functional components required for the trainer are identified as follows:

(a). Center Bay

(1) Center Instrument Panel

- a. Head Up Display (HUD)
- b. Left Digital Display Indicator (LDDI)
- c. Right Digital Display Indicator (RDDI)
- d. Horizontal Indicator (HI)
- e. Master Arm Panel
- f. Left Threat Display



- | | |
|----------------------------|------------------------------|
| 1 Visual Display | 9 ALR-67 Control Indicator |
| 2 Shoot Indicator | 10 ECM Control Panel |
| 3 HUD | 11 Throttle |
| 4 Up Front Control Panel | 12 Control Stick |
| 5 Left DDI | 13 Sensor Control Panel |
| 6 Right DDI | 14 Trainer Operation Console |
| 7 Horizontal Indicator | 15 Computer & Peripherals |
| 8 ALR-67 Azimuth Indicator | 16 Visual Computer |

F/A-18 HOTAS Part Task Trainer Conceptual Outline

FIGURE 1

- g. ALR-67 Azimuth Indicator
- h. ALR-67 Control Indicator
- i. ECM Control Panel
- j. Shoot Cue Light
- k. Integrated Fuel/Engine Indicator
- l. Up Front Control Panel (Partial Simulation)

(2) Flight Control Stick

- a. Control stick shall be functional; response to its movement shall be the same as in the aircraft
- b. Switches/Controls to be functionally simulated are:
 - 1. Air-to-Air Weapon Select Switch
 - 2. Sensor Control Switch
 - 3. Guns/Missiles Trigger Switch
 - 4. Air-to-Ground Weapon Release Switch
- c. Control stick switches which are not required to be functional, but shall be represented and movable are:
 - 1. Trim Switch
 - 2. Bar. Alt. Reset/Undesigned/NWG Switch
 - 3. Auto. Pilot/NWS Dis./G-Limiter Switch

(b) Left Console

(1) Power Control Quadrant with Throttles

- a. Throttles shall be functional, movement and response shall be the same as in the aircraft
- b. Switches/Controls to be functionally simulated are:

1. Throttle Designator Control (TDC)
2. Radar Elevation Switch
3. HARM Sequence/FLIR/FOV/RAID Switch
4. Cage/Uncage Switch
5. Chaff/Flare Dispenser Switch

c. Throttle switches which are not required to be functional, but shall be represented and movable are:

1. Communications Switch
2. Speed Brake Switch
3. Automatic Throttle Control (ATC) Switch
4. Exterior Lights Switch

(c) Right Console

(1) Sensor Control Panel and Controls and Indicators

3.2.2 Simulation Performance. Device/flight simulation shall be initiated with the aircraft in flight and in a clean configuration (gear and flaps in up position). External stores will be carried and shall vary with each training scenario. No ground handling, takeoff and landing simulation shall be required. The performance, flying qualities, functional aircraft systems, electronic equipment, instrument/display response, and control reaction shall be simulated to correspond to the F/A-18 aircraft.

3.2.2.1 Freedom of Motion. The trainer shall provide simulation of the dynamics of the F/A-18 aircraft based on solution of six degrees of freedom equations of motion. The simulated aircraft shall respond to flight and power plant controls and the simulated environment corresponding to the F/A-18 aircraft.

3.2.2.2 Aerodynamic Effects. Simulation shall include aerodynamic effects for altitudes up to 40,000 feet and Mach numbers below 1.6.

3.2.2.2.1 Center of Gravity. Changes in the center of gravity shall be simulated as a result of full consumption and release of external stores.

3.2.2.2.2 Gross Weight. The weight range of the F/A-18 aircraft shall be simulated as established by the external stores and fuel consumption.

3.2.2.3 External Stores. Simulation of aerodynamic, weight, center of gravity effects shall be provided for the aircrafts' external stores stations and all configurations of external stores.

3.2.2.4 Crash Simulation. Whenever simulated flight conditions exceed operating limits of the aircraft, or the aircraft flight path intersects with ground, water, or with another aircraft, a crash will occur with an indication on the visual display.

3.2.3 Aircraft Systems. The following systems shall be simulated for normal operation and shall affect the flight characteristics, control responses and instrument/display readings.

3.2.3.1 Powerplant Systems. The F404-GE-400 engines of the F/A-18 aircraft shall be simulated for normal operation and afterburner capability together with the related controls and instruments indicating fuel consumption. No engine starting and shutdown simulation is required.

3.2.3.2 Fuel System. The fuel system of the F/A-18 aircraft shall be simulated for quantity indication, weight and center of gravity. Fuel consumption shall be affected by the aircraft power settings and reflected in the fuel indicator.

3.2.3.3 Electrical Power Supply System. The electrical system shall be simulated to the extent of trainee station indication and control activation for systems being simulated.

3.2.3.4 Flight Control System. The flight controls of the F/A-18 shall be simulated for feel and aerodynamic response.

- (a) Control stick HOTAS controls shall be simulated as indicated in 3.2.1(a)(2).
- (b) Rudder pedals shall not be simulated. Rudder functions shall integrated with the flight control stick.

3.2.3.5 Aircraft Computers. Function of the aircraft computers (Mission Computers, Armament Control - Processor Set, HARM Command Launch Computers) shall be simulated to the degree required to accomplish the training objectives.

3.2.3.6 Navigation and Flight Aids. Function of the aircraft navigation system shall be simulated to the degree required to provide course data during training scenarios.

3.2.3.7 System Displays. The simulation of the F/A-18 aircraft displays shall be as specified herein.

- (a) Left Digital Display Indicator (DDI), including night/auto/day switch, contrast control, brightness control and push-button request functions. Displays shall include the stores displays, acquisition symbols and indications of the throttle designator control (TDC), sensor select and cage/uncage switch. The left DDI shall provide back-up capability for the right DDI, horizontal indicator (HI) and HUD.
- (b) Right DDI including night/auto/day switch, contrast control, brightness control, and push-button request functions. Displays shall include radar displays (both air-to-air and air-to-ground), FLIR displays, HARM displays, acquisition symbols, target tracking (air-to-air only), and indications of radar mode switch. The right DDI shall provide back up capability for the left DDI.

- (c) Horizontal Indicator (HI) including night/auto/day switch, contract control, brightness control and push-button request function. Displays shall include moving map displays, speed, heading and course readouts, and sensor switch indications.
- (d) Head-up display (HUD), including the HUD control panel and associated controls. HUD displays shall include acquisition symbols, sight recticle, steering data, altitude, attitude, airspeed, throttle designator control and sensor select indications.

3.2.3.8 Up Front Control (UFC). Limited operation of the UFC and its controls shall be simulated to enable the trainee to enter target information for the HARM target of opportunity (TOO) mode of operation.

3.2.4 Electronic Countermeasures (ECM). Performance characteristics of the corresponding ECM equipment aboard the F/A-18 shall be simulated. Activation of the simulated ECM equipment shall appropriately affect relevant displays, indicators and aural tones as in the F/A-18 aircraft. The ECM simulation shall include the ALR-67, ALQ-126B and ALE-39 systems as follows:

- (a) ALR-67, Radar Warning Receiver, Functions of the ALR-67 threat processor shall be simulated to allow operation of the ALR-67 azimuth and control indicators. Simulations shall include interfaces with the following:
 - (1) Aircraft electrical system
 - (2) Mission computers
 - (3) AGM 88 HARM systems
 - (4) Cockpit threat lights
- (b) ALQ-126B, Countermeasures Set. Simulations shall include the ALQ-126B operating modes as selected from the ECM control panel (OFF STBY, REC, RPT)

- (c) ALE-39, Countermeasures Dispensing Set. Simulation shall include the Chaff/Flare switch on the throttle and the Chaff/Jammer controls on the ECM control panel.

3.2.4.1 Countermeasures Systems. The F/A-18 countermeasures systems shall be simulated to include Chaff, Flares, and RF Jammer. Functions of the Dispense Select Switch, Mode Select Switch, RWR Switch, ECM Mode Switch, Chaff/Flare/Jammer Counters and throttle Chaff/Flare Dispenser Switch shall be simulated.

3.2.5 High Speed Anti-Radiation Missile System (AGM-88 HARM). The HARM seeker, range, and missile dynamics shall be simulated.

- (a) All modes of HARM system operation shall be simulated:

- (1) Prebrief Mode
- (2) Target of Opportunity (TOO) Mode
- (3) Self Protect Mode

- (b) When operating in a HARM mode, the tactical displays of the HARM system shall correlate with others on board aircraft detection systems.

- (c) The simulated tactical environment shall be the same as the ALR-67 system and radar landmass simulation. Simulation shall include:

- (1) Surface-to-Air Missile (SAM) sites
- (2) Anti Aircraft Artillery (AAA) sites
- (3) Ground Control Intercept radar sites
- (4) Early Warning radar sites

3.2.6 Tactical Sensors Simulation. The F/A-18 aircraft tactical sensors shall be simulated to the extent specified in 3.2.6.1 through 3.2.6.3.

3.2.6.1 Radar Set, (AN/APG-65). The F/A-18 radar, controls and displays and modes of operation shall be simulated to operate as in the aircraft.

3.2.6.1.1 Air-to-Air Radar Modes. The air-to-air radar modes shall be simulated as follows:

- (a) Automatic sensor/display initialization via HOTAS controls including weapons selection and automatic acquisition shall be provided.
- (b) All radar related controls, switches and displays shall be provided.
- (c) All radar ECCM and NCTR features shall be provided.
- (d) The multiple capability of maintaining a track file of ten targets and to display, track, and discriminate between up to eight targets shall be provided.
- (e) At the range of five nautical miles and less, the radar targets shall correlate with the visual counterpart in terms of space and time, and spectral detail.
- (f) The simulated air-to-air radar environment shall correlate with the air-to-air visual geographic environment.
- (g) The air-to-air radar modes, listed below, and labeled "F" (Functional) shall be simulated to operate as in the AN/APG-65 radar. The modes labeled "NF" (Non-Functional) shall not be simulated but provision for future incorporation shall be provided.

(1) Range While Search (RWS)	F
(2) Single Target Track (STT)	F
(3) Non-Cooperative Target Recognition (NCTR)	F
(4) Electronic Counter - Counter Measures (ECCM)	F
(5) Auto Acquisition (AACQ)	F
(6) Gun Acquisition (GACQ)	F
(7) Track While Scan (TWS)	NF

- | | | |
|-----|-----------------------------|----|
| (8) | Vertical Acquisition (VACQ) | NF |
| (9) | Raid Assessment (RAID) | NF |

3.2.6.1.2 Air-to-Ground Radar Modes. The Air-to-Ground radar modes shall be simulated as follows:

- (a) All radar related controls, switches and displays shall be provided.
- (b) HOTAS controls shall operate as in the aircraft.
- (c) The radar simulation shall operate with a Data Radar Landmass Simulation (DRLMS) to provide complete radar simulation for the radar displays.
- (d) The air-to-ground modes, listed below, and labeled "F" (Functional) shall be simulated to operate as in the APG-65 radar. The modes labeled "NF" (Non-Functional) shall not be simulated but provisions for future incorporation shall be provided:

- | | | |
|-----|--|----|
| (1) | Doppler Beam Sharpened Patch (EXP2) | F |
| (2) | Air-to-Ground Ranging (AGR) | F |
| (3) | Real Beam Map (MAP) | F |
| (4) | Ground Moving Target (GMT) | NF |
| (5) | Sea Surface Search (SEA) | NF |
| (6) | Doppler Beam Sharpened Patch (EXP 1) | NF |
| (7) | Medium Resolution Synthetic Aperture (EXP 3) | NF |
| (8) | Terrain Avoidance (TA) | NF |
| (9) | Provision Velocity Update (PVU) | NF |

3.2.6.2 Forward Looking Infrared (FLIR). FLIR capability shall be simulated to the extent specified herein.

- (a) Functions of the FLIR pod shall be simulated to provide the infrared imagery to the cockpit displays.
- (b) All related FLIR controls, switches and displays shall be provided.

- (c) In the air-to-air mode FLIR shall be integrated with the radar.
- (d) The simulated tactical environment shall be same as the air-to-air mode, air-to-ground mode and ALR-67.

3.2.6.3 Laser Spot Tracker/Strike Camera (LST/SCAM). The LST/SCAM shall not be simulated. All LST/SCAM controls and switches shall be provided but shall be non-functional.

3.2.7 Weapons (Armament). Own aircraft armament shall be simulated to the extent specified herein:

- (a) M62A1-20mm gun
- (b) AIM-7F/7M (Sparrow)
- (c) AIM-9L/9M (Sidewinder)
- (d) AGM-88A-HARM
- (e) External Fuel Tanks
- (f) Simulation shall include the weapons' guidance and aerodynamic characteristics, range, accuracy, and lethal radius.
- (g) Loading position, firing order, and quantity of each type of armament shall be specified in the training scenario/initial condition set-up.

3.2.7.1 Stores Management Set (SMS) (Armament Control Processor). Functions of the SMS shall be simulated to provide Stores Format displays on the DDI for the selected weapon.

3.2.8 Tactical Environment. The simulated tactical environment shall not be limited to any specific geographic location. The tactical environment shall include airspace from sea level to 50,000 feet and ground range of 600 nautical miles by 600 nautical miles spherical earth simulation. The tactical environment shall simulate the geographic domain in which the trainer shall operate. It shall provide the visual and radar environment and consist of air targets, ground targets, air combat maneuvering, air-to-air

weapons delivery, air-to-ground weapons delivery, ECM, radar warning receiver threats such as SAM, AAA, and early warning radars.

3.2.8.1 Air Targets. Six threat aircraft (red aircraft) e.g. MIG-29, MIG-31, or SU-27 (exact type to be determined by the PCO) shall be simulated which shall fly a preprogrammed profile, depending on the training scenario, and will break from these profiles to attack the ownship (blue aircraft) with air-to-air missiles. The aerodynamic characteristics associated with each air target shall be accurately simulated. The six threat aircraft shall be programmed to operate as a single formation of two, three, four or all six. Radar Infrared (IR) cross-sectional areas and aspect modulation shall be provided for all air targets. Detectability of individual targets shall be preordained during the formulation of the training scenarios and/or initial conditions. Air targets shall be displayed on the radar display (DDI) within the range capability of the radar. The radar scene shall correlate with the visual gaming area. All air targets shall be capable of launching missiles, firing guns, and carrying countermeasures. The particular aerodynamic and lethality characteristics associated with each air-to-air missile and gunfire for each air target shall be accurately simulated. Air targets shall be capable of carrying airborne intercept radar that shall interact with the simulated ALR-67 system in the trainee station. Target dynamics shall be controlled by an interactive computer program with the capability of attack or evasion against the trainee station.

3.2.8.2 Surface Targets. A total of eight surface to air (SAMs), anti-aircraft artillery (AAA), and early warning radar sites shall be simulated. The total number of ground threats shall be thirty. Grouping of the SAM and AAA batteries and early warning radar (e.g. 6 SAM batteries, 6 AAA batteries, 1 early warning radar) into an air defense system shall be determined by the PCO. Flexibility to vary the grouping in each training scenario shall be provided. Each site shall consist of a source of electromagnetic emissions

and shall constitute an origin for missile launches against own aircraft. The electromagnetic emission characteristics:

- (a) Associated with each SAM site and the aerodynamic and lethality characteristics for each SAM shall be accurately simulated.
- (b) Of the AAA sites and the aerodynamic and lethality characteristics of the associated gunfire shall be accurately simulated.
- (c) Associated with early warning radar shall be accurately simulated.
- (d) Associated with each SAM, AAA, and early warning radars shall interact with the simulated ALR-67 system in the trainee station.

3.2.8.3 Other Target Requirements. Additional target related requirements are as follows:

- (a) Visual cues shall include indications of opposing aircraft firing guns and missile launch signatures.
- (b) A hit scored by own aircraft on a target shall cause the target to explode.
- (c) A hit scored on own aircraft by a target shall be indicated by a red flash.
- (d) Visual indications shall include indication of threat aircraft selecting/deselecting afterburner operation.
- (e) SAM launch and trajectory shall be visually simulated, allowing trainee to take defensive action. All SAM missile information detected by the simulated ALR-67 system shall correlate with the visual presentation.
- (f) Missile firing by own aircraft shall be confirmed by a visual presentation of the missile launch signature.
- (g) Scoring of missile and gun hits on threat aircraft and miss parameters shall be via printout. Parameter to be determined by PCO.

- (h) Scoring of AAA or SAM hits on own aircraft shall be provided with a printout of parameters. Parameters to be determined by the PCO.

3.2.9 Visual System. The visual system shall be mounted on the front bay of the trainee station and shall provide a real-time, out the window display of a day/dusk/night visual scene having the appropriate cues to accomplish the training objectives. The visual scene shall be comprised of three-dimensional objects, surface and lights with correct prospective, color, texture, location, resolution, luminance, etc. relative to the pilots eye point. The visual system shall have a unobstructed Field-of-View (FOV) of a minimum of 60 degrees Horizontal by 40 degrees Vertical. The HUD may be superimposed on the visual scene in correct prospective, if technically feasible.

3.2.9.1 Simulated Visual Environment. The system shall provide simulation of visual objects, effects, and geographic areas as specified in 3.1.1 and 3.2.8 and subparagraphs thereto. The simulated environment in addition to paragraphs 3.1.1 and 3.2.8, shall contain potential ground targets such as an airfield, refineries, factories, dams, etc. and three dimensional natural objects. The visual environment shall correlate with the simulated radar and ALR-67 data bases. The terrain of the visual environment shall be derived from Digital Terrain Elevation Data.

3.2.9.1.1 Visual Environment Design. The following priorities shall apply to the visual environment design:

- (a) Provide the visual cues needed to accomplish the related training objectives. Utilize the same cues which are used in the aircraft.
- (b) System response shall be consistent with F/A-18 aircraft dynamics and adequate to preclude system response delays which would degrade performance.

- (c) Visual scene fidelity shall be sufficient to provide visual sensation of flight and the illusion of realism.
- (d) Displayed area of coverage and shape shall be the function of normal altitudes and airspeeds involved in the training tasks.
- (e) A single aircraft designated as wingman, when identified in specified training scenarios, shall follow the flight path of the lead F/A-18 aircraft and shall use its aircraft resources to protect the lead aircraft and destroy the threat aircraft while avoiding destruction.

3.2.10 Trainer Operation Console. The trainer operation console shall enable the trainee to set-up, select, initiate, operate and control the training exercise without the requirement for an Instructor/Operator. The trainer operation console shall be located adjacent to the right console of the trainee station within easy reach of the trainee. The console shall consist of Cathode Ray Tube (CRT) display, CRT touch controls, functional keyboard, and control switches. Maximum use of the CRT display system, CRT touch controls, and functional keyboard shall be made to allow for ease of trainer operation. Maximum use of automated functions shall be made to minimize the number of steps required to accomplish the training exercise.

3.2.10.1 Trainer Operation Console Components. Major components of the Trainer Operation Console shall include the following:

- (a) Trainer power on-off control.
- (b) Visual display power on-of, brightness focus, vertical and horizontal, hold controls, etc.
- (c) CRT displays controls, brightness, focus etc.
- (d) Console training function controls i.e. operate, freeze, reset, stop, playback.

3.2.10.2 Trainer Console Operation. The CRT touch controls and alphanumeric keyboard shall provide for data entry and training scenario initiation and control. The trainer shall operate in four modes of operation; the Operator Training Mode, Plan Mode, Training Mode and Test Mode. Selection of the mode of operation shall be made from the menu display on the CRT console.

3.2.10.2.1 Operator Training Mode. The trainer shall be designed, in the absence of a simulator instructor/operator, to include an operation training program for the trainee before utilizing the trainer as a training vehicle. The operator training mode shall be used to tutor the trainee on the capabilities of the trainer, with emphasis on the controls, displays, training objectives, training scenarios and performance measurements.

3.2.10.2.2 Plan Mode. The plan mode shall provide the setup of initial conditions for air-to-air, air-to-ground, and air-to-air/air-to-ground combinations, offensive, and defensive tactics, training scenarios. Approximately 20 initial condition sets shall be provided for each air-to-air, air-to-ground, and air-to-air/air-to-ground mode of operation. The exact number and combination of initial conditions and training scenarios shall be determined by the PCO.

3.2.10.2.2.1 Initial Conditions. Each initial condition selected from the list of initial condition sets from either the air-to-air mode, air-to-ground mode or the combination of air-to-air/air-to-ground modes shall provide a detailed description of the training environment and the objective of the training scenario. As a minimum the following shall be provided:

- (a) Type of mission
- (b) Aircraft in flight, altitude and airspeed
- (c) Aircraft location within tactical environment
- (d) Weather, visibility, wind
- (e) Aircraft weapons configuration

- (f) Type of threats - air/ground
- (g) Location of ground threats
- (h) Fuel quantity in aircraft

The ability to change parameters within the initial conditions to accommodate change in training requirements shall be provided.

3.2.10.2.2.2 Training Scenarios. The training scenarios shall be designed to accomplish the training objective identified in 3.1.1.1. The design of the scenarios shall consider the constraints of the visual display field-of-view (FOV). The training scenarios shall evolve from the initial conditions identified in 3.2.10.2.2.1 and shall consider the following:

(a) Air-to-Air Mode

- (1) Composition of threat aircraft and missiles
- (2) Number and types of incoming missiles
- (3) Use of radar and FLIR
- (4) Use of Radar Warning Receiver (RWR)
- (5) Electronic Countermeasures
- (6) Delivery of Sparrow and Sidewinder missiles

(b) Air-to-Ground Mode

- (1) Composition of AAA, SAM, and search radars
- (2) Location, number, and types of ground threat emitters
- (3) Use of radar and FLIR
- (4) Use of Radar Warning Receiver (RWR)
- (5) Electronic Countermeasures
- (6) Delivery of HARM missile

Final composition of the training scenarios shall be determined by the PCO.

3.2.10.2.3 Training Mode. The training mode shall initiate and control the training session. Once the initial condition has been selected and the trainer "operate" control activated, the training shall start. The CRT console display shall present a god's-eye-view of the gaming area showing the entire gaming area, location and track of ownship, location of air threats/emitters; and location of ground threats/emitters. The training exercise shall end when stopped by the trainee; fuel has been exhausted; armament expended; ownship shot down; or crash.

3.2.10.2.3.1 Console Controls. The following controls shall be provided at the trainer operation console.

3.2.10.2.3.1.1 Freeze. Activation of the freeze control shall stop the trainer at any point in the training exercise. Deactivation of the freeze control shall release the trainer to continue the training exercise from the point of interruption.

3.2.10.2.3.1.2 Reset. Activation of the reset control shall return the trainee station to the initial condition. Activation of the reset control shall erase any replay data.

3.2.10.2.3.1.3 Record/Replay. Whenever the trainer is operating in the training mode, the computer shall automatically record the trainer performance of the most recent 20 minutes of trainer performance for playback. The record control shall be activated if playback is not desired. A replay control shall provide the capability to replay the entire 20 minute record or any segment thereof in increments of 20 seconds. When replay is selected the computer shall set up the trainee station, indicator, cockpit displays and visual displays to the portion corresponding to the selected record; flight and throttle controls shall not require movement during the replay. The replay control shall have the capability to stop the replay at any time and return the trainee station to the training mode (flyout from replay).

3.2.10.2.3.1.4 Performance Evaluation. A continuous recording of the following parameters, for both air-to-air and air-to-ground offensive and defensive tactics shall be available for playback on the console CRT during the replay function:

- (a) Ownship heading, altitude and airspeed.
- (b) Sidewinder delivery, range, velocity, hit or miss rationale for miss.
- (c) Sparrow delivery, range, velocity, hit or miss rationale for miss.
- (d) Gun attack, range, hit or miss. Number of hits scored. Rationale for miss.
- (e) HARM delivery, range, hit target or miss, miss distance. Rationale for miss.
- (f) Jamming effectiveness. Results of use of RF jamming, flares, and chaff.

3.2.10.2.4 Test Mode. The test mode shall provide the trainee the means to checkout the trainer for ready-for-training status. Activation of the test control shall initiate an automatic self-test trainer readiness check program. Status of the trainer system shall be indicated on the trainer operation CRT console.

3.2.11 General Requirements - Digital Computer System. The computer system shall consist of a commercial general purpose digital computer including all processor units, memory units, mass storage units, input-output (I/O) interface equipment, special interface equipment, display and visual system processor and power supplies required for the trainer. The computer system shall meet all functional, operational, simulation, control processing, and design requirements of this specification. The computer system shall be located adjacent to the trainee station.

3.2.11.1 Digital Computer Configuration. Only commercially available general-purpose digital computers (processors) and associated peripheral devices that are currently in production and

in general use by other than the computer manufacturer shall be selected to satisfy the requirements of this specification.

3.2.11.1.1 Digital Computer Speed. The computer processor(s) shall have adequate arithmetic, logical processing, input-output, and memory access speeds to assure real-time processing of all assigned functions (e.g. simulation, control, and the like). The processor(s) shall be sized, and the program(s) shall be designed and organized, for execution at speeds which will assure no discernible or discrete stepping, oscillating, jittering or erratic behavior in display or instrument indications.

3.2.11.1.2 System Memory. Sufficient memory shall be provided and installed with the processor(s) and shall be used to store the total real-time programs required to complete simulation, control and executive functions, and all constants, real-time data operands, intermediate results, and required spare capacity.

3.2.11.1.3 System Spare Capacity. System spare capacity shall comply with the requirements of MIL-STD-1644B.

3.2.11.1.4 Power Fail-Safe Provisions. A power fail-safe interrupt shall be included with the processor(s) to sense impending power failure and bring processing to an orderly halt. Power failure or emergency interruptions of power to the trainer and/or computer system shall not result in physical or electrical damage to the computer system equipments. Restart of the computer system after momentary power failures shall be accomplished automatically. The training exercise shall be resumed at the point of interruption.

3.2.11.1.5 Running Time Meter. A running time meter shall be installed on the processor(s) and shall indicate the elapsed time on processor. The meter shall display at least five digits in increments of 0.1 hour and shall not be resettable.

3.2.11.1.6 Peripheral Equipment. Computer peripheral equipment shall be provided and installed to support the digital computer system in meeting the requirements of this specification.

3.2.11.1.7 Interface Equipment. The interface equipment shall include all input/output conversion equipment and discrete inputs and outputs. The interface shall be designed to permit sampling of controls and activation of displays and the like with sufficient speed and accuracy to meet the requirements of this specification.

3.2.11.2 Computer System Software. Computer system software shall be designed, developed, and documented in accordance with the MIL-STD-1644 in effect as of the date of this RFP.

3.2.11.2.1 Required Computer Programs. The trainer shall include all the programs required by the specification. Computer programs shall be developed to perform real-time simulation and control processing and other functions as required by this specification.

3.2.11.2.1.1 Operating System Software. Only commercially available operating system software for the selected computer shall be used. The vendor-supplied operating system software shall not be modified by the device developers.

3.2.11.2.1.2 Maintenance and Test Programs. The maintenance and test programs shall test the operation of all computer system and trainer equipment. When a malfunction occurs in the trainer equipment, these programs shall provide sufficient information to the operator to facilitate location and correction of the malfunction.

3.2.11.2.1.2.1 Daily Operational Readiness Test (DORT). The DORT shall be designed to enable operating (trainee) and maintenance personnel to automatically assess the operational condition of the trainer and to isolate any faults discovered. The DORT shall include a thorough checkout of the trainee station, trainer

operation console, interface equipment, and visual system. The DORT program shall be designed for use by the operator (trainee) or maintenance personnel (Electronics Technician aboard a carrier). The DORT program shall be called up at the trainer operation console.

3.2.11.2.1.2.2 Computer Diagnostic Programs. Only commercially available diagnostic programs for the selected computer (s) shall be used. These programs shall be automatic and require minimum operator effort.

3.3 Materials, Parts, and Processes. The materials, parts, and processes used in the design and construction of this trainer shall conform to best commercial practices and standards.

3.3.1 Asbestos Exception. Materials and parts shall not contain asbestos.

3.4 Nameplate and Product Markings. The trainer nameplate and product marking shall be specified by NAVTRASYSSEN.

3.5 Electromagnetic Interference (EMI) Suppression. All equipment shall be properly protected from electromagnetic radiation effects. This protection shall also eliminate emanation of any internally-generated electromagnetic radiation that would be harmful to other equipment.

3.6 Trainer Facility. The trainer shall be designed to operate in a room aboard a carrier, conditioned for personnel comfort.

3.6.1 Trainer Room Size. The trainer shall be designed to be housed in a room approximately 10 feet by 10 feet.

3.6.2 Electrical Power. The trainer shall be designed to utilize 60 Hertz power.

3.6.3 Environmental Limits. The trainer shall operate satisfactorily in temperatures of 60 degrees to 80 degrees Fahrenheit with a 40 to 75 percent relative humidity.

3.6.4 Trainer Equipment. All trainer equipment shall be capable of passage through a 36-inch by 80-inch high door opening.

3.6.5 Facility/Trainer Interface. The contractor shall provide all labor and material necessary to connect the trainer to the Government-furnished facilities.

3.6.6 Trainer Lighting. Adequate indirect lighting shall be provided for the trainer station.

3.7 Transportability. The trainer shall be designed to be transportable to installation site by standard commercial transportation. Components shall be constructed so that installation and assembly can be accomplished with a minimum of special equipment or tools.

3.7.1 Strength. The trainer shall withstand, without damage, stresses incident to movement, handling in transit, hoisting, tie-down aboard transporting vehicles, final installation, and use.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 General Quality Assurance Provisions. The program shall ensure quality throughout all areas of the specification requirements including design, development, fabrication, assembly, inspection, test, preparation for delivery, shipping, storage, and site installation.

4.2 Responsibility for Inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements. Except as otherwise specified in the contract, the contractor may use his own facilities suitable for

performance of the inspection requirements, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.3 Classification of Inspections. Inspections to be performed are classified as follows:

- (a) In-process inspections
- (b) Quality conformance inspection

4.3.1 In-Process Inspection. The in-process inspection shall include such visual, electrical, and mechanical examination, and testing of materials, parts, and accessories during the manufacturing process of the trainer as may be required to assure conformance to the respective requirements of this specification.

4.3.2 Quality Conformance Inspection. The quality conformance inspection shall be in accordance with a Government-approved test report and shall consist of the following examinations and tests.

4.3.2.1 Examinations. The examination shall be in accordance with MIL-T-29331.

4.3.2.2 Tests. The tests shall be performed to demonstrate that the trainer operation conforms to the requirements of this specification and shall include all types of tests including the following:

- (a) Computer system software
- (b) Functional
- (c) Visual system
- (d) Trainer operation
- (e) Electrical
- (f) Environmental

- (g) Human factor
- (h) EMI suppression
- (i) Training program scenarios
- (j) Maintainability

5.0 PREPARATION FOR DELIVERY

5.1 Preparation for Delivery Requirements. Since final acceptance will take place at the installation site, there are no specific preparations for delivery requirements. The trainer shall be packaged, packed, and marked in a manner that will ensure acceptance by common carrier and safe delivery at destination.

6.0 NOTES

6.1 Intended Use. The F/A-18 HOTAS port-task trainer will be used to provide training to Navy pilots, when deployed aboard a carrier, in the use of the HOTAS controls in the F/A-18 air-to-air and air-to-ground modes of operation.

6.1.1 Trainees. The trainees will consist of Navy pilots who are qualified to fly the F/A-18 aircraft.

6.1.2 Mode of Training. The training and operation of the device will be conducted by the trainee without the assistance of an instructor or operator.

6.2 Maintenance Concept. With the trainer stationed aboard a carrier, the concept of maintenance will be to provide proper maintenance services without disruption of training. It is anticipated an electronics technician aboard the carrier will be assigned to perform maintenance on the trainer as required. A trainer support package, including maintenance and diagnostic manuals and spare parts, will accompany the trainer.

7.0 ACRONYMS

AAA	Anti-Aircraft Artillery
AACQ	Auto Acquisition
AGR	Air-to-Ground Ranging
AOA	Angle-of-Attack
ATC	Automatic Throttle Control
CRT	Cathode Ray Tube
DDI	Digital Display Indicator
DORT	Daily Operational Readiness Test
DRLMS	Digital Radar Landmass Simulation
ECM	Electronic Countermeasures
ECCM	Electronic Counter Countermeasures
EMI	Electromagnetic Interference
EXP1	Doppler Beam Sharpened - Sector
EXP2	Doppler Beam Sharpened - Patch
EXP3	Medium Resolution Synthetic Aperture
FLIR	Forward Looking Infrared Radar
FOV	Field-of-View
GACQ	Gun Acquisition
GMT	Ground Moving Target
HARM	High Speed Anti-Radiation Missile
HI	Horizontal Indicator
HOTAS	Hands-On-Throttle-and-Stick
HUD	Heads-Up Display
I/O	Input/Output
IR	Infrared
LST	Laser Spot Tracker
MAP	Real Beam Map
NCTR	Non-Cooperative Target Recognition
PCO	Procurement Contracting Officer
PVU	Precision Velocity Update
RAID	Raid Assessment
RF	Radio Frequency
RWR	Radar Warning Receiver
RWS	Range While Search
SAM	Surface-to-Air Missile

SEA	Sea Surface Search
SCAM	Strike Camera
SMS	Stores Management Sat
SP	Self-Protect
STT	Single Target Track
TA	Terrain Avoidance
TDC	Throttle Designator Control
TOO	Target-of-Opportunity
TWS	Track While Scan
UFC	Up Front Control
VACQ	Vertical Acquisition