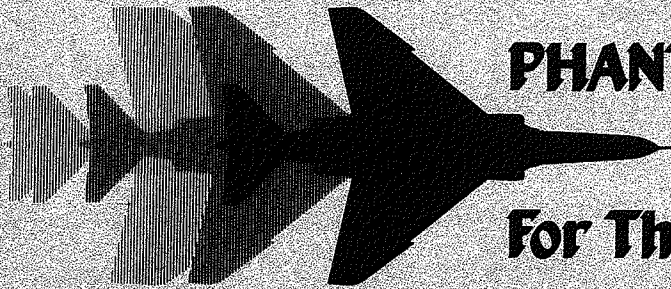


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F-4 MODERNIZATION PROGRAM



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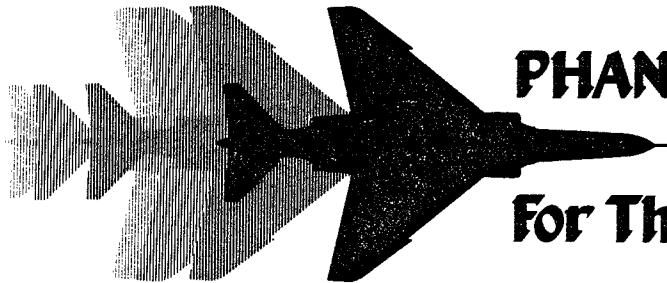
MCDONNELL AIRCRAFT COMPANY PROPOSAL
SOLICITATION NUMBER F33657-85-R-0044
USAF/AFSC
AERONAUTICAL SYSTEMS DIVISION
ATTENTION: ASD/TAAC
WRIGHT-PATTERSON AFB, OHIO 45433

MCDONNELL AIRCRAFT COMPANY

MCDONNELL DOUGLAS



F-4 MODERNIZATION PROGRAM



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**MCDONNELL AIRCRAFT COMPANY PROPOSAL
SOLICITATION NUMBER F33657-85-R-0044
USAF/AFSC
AERONAUTICAL SYSTEMS DIVISION
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WRIGHT-PATTERSON AFB, OHIO 45433**

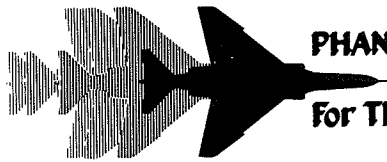
This data shall not be disclosed outside the Government or be duplicated, used, or disclosed in whole or in part for any purpose other than to evaluate the proposal; provided, that if a contract is awarded to this Contractor as a result of, or in connection with, the submission of such data, the Government shall have the right to duplicate, use, or disclose the data to the extent provided in the contract. This restriction does not limit the Government's right to use information contained in such data if it is obtained from another source.

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FOREWORD

McDonnell Aircraft Company (MCAIR), a division of the McDonnell Douglas Corporation (MDC), is pleased to submit this proposal to the Department of the Air Force, Headquarters - Aeronautical Systems Division (ASD) for the F-4 Modernization Demonstration Program. Our program is fully responsive to the requirements of Request for Proposal F33657-85-R-0044, dated 15 October 1984. However, some alternatives are recommended in the addendum to Volume I. Our proposal consists of four volumes which describe our approach to fulfilling the ASD requirements. In addition, an Executive Summary highlights the major features of the proposal.

-	Executive Summary
Volume I	Technical
Volume II	Management
Volume III	Past Performance
Volume IV	Price and Delivery

Executive Summary - As designers and manufacturers of fifteen models of the Phantom II and as avionics integrators of the F-4G Wild Weasel Performance Update Program, MCAIR is vitally interested in performing the F-4 Modernization Demonstration Program - the Phantom II+. Our team is in place and working on the program. MCAIR believes the Phantom II+ program is a necessary and timely step toward maintaining the strength of the free world's Air Force.

Volume I Technical - MCAIR proposes the advanced technology J79-GE-17H engine, avionics trade studies featuring manned simulation and above the wing conformal fuel tanks. A cost effective alternate proposal is also included which reflects the MCAIR recommended approach.

Volume II Management - MCAIR has evolved a highly competent management organization and an effective management system to carry out the production and support operations for our aircraft that are used throughout the free world. Thousands of suppliers and subcontractors are directly involved with MCAIR on each program. The dedication and skill of MCAIR management has thus been consistently demonstrated.

MCAIR's proposed approach to conducting the program makes extensive use of our current capabilities. Our team provides:

- o F/RF-4 systems engineering and management experience gained as prime contractor on 15 models of the aircraft
- o Thorough understanding of Air Force requirements and thorough familiarity with the F-4 aircraft
- o Objectivity in selecting avionic suppliers, since MCAIR is not an avionics manufacturer
- o Proven engine integration experience including 22 versions of the J79 engine and several versions of the Rolls Royce Spey engine
- o Excellent experience in avionics retrofit programs including the F-4G/APR-38 Wild Weasel and the Wild Weasel Performance Update Program
- o Proven evaluation capability with the Manned Air Combat Simulator
- o Proven expertise in design, development and production of conformal fuel tanks for the F-15

Volume IV Price and Delivery - Detailed cost information and schedules are included for the proposal and alternate proposal.

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Information contained herein is proprietary
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and its participating subcontractors.

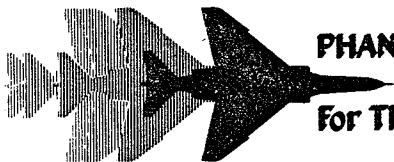
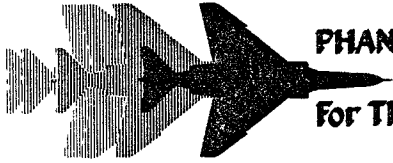


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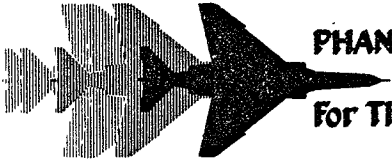
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INTRODUCTION

This volume depicts MCAIR's past performance in response to the requirements of RFP F33657-85-R-0044, Section L, Paragraph 4. This information covers successful performance in three categories; aircraft development and modification programs, Wild Weasel programs, and recent/current contract research and development programs. This information makes it clear that MCAIR:

- o Can establish realistic projected program costs and schedules;
- o Has a long term, continuous and current expertise in design, development and management of complex, state-of-the-art avionics hardware and software programs;
- o Can manage complex programs with substantial subcontract effort such that system performance meets specification requirements, with delivery on-time and within proposed cost.



1. RELEVANT PAST PERFORMANCE

MCAIR is a prime contractor to the USAF, USN, and NASA on many research, design, development and production programs, and has continuous long-term experience in engineering design, integration and management of complex, state-of-the-art avionics programs. MCAIR has performed weapon system design studies involving aircraft synthesis, technology integration, weapon and subsystem tradeoffs and analyses, and aircraft and missile simulations. Laboratory, flight simulation and flight test facilities are used as appropriate to develop, demonstrate and validate advanced concepts, technology, and equipment.

Studies and programs such as these have culminated in successful programs such as the F-4G Wild Weasel, F-15 Dual Role Fighter, F-15 STOL Fighter Technology, and the F-15 Conformal Fuel Tanks (CFT's) with tangential weapons carriage.

In these programs, MCAIR has been responsible for selecting/designing, integrating, and testing airborne electronics, airframe and engine modifications to establish system performance, in support of a production decision.

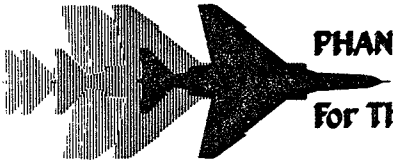
1.1 RELEVANT MCAIR CONTRACTS

Recent MCAIR contracted studies and programs relevant to this program are summarized in Figure 1-1 and a brief description of each program is presented in the following paragraphs. Experience gained on these programs will be applied to the F-4 Modernization Demonstration Program. Our F-15 STOL Fighter Technology, F-15 CFT, F-15 DRF and AV-8B Radar Simulation experience is particularly pertinent in that much of the key technology is applicable to this program.

1.1.1 DERIVATIVE FIGHTER COMPARATIVE EVALUATION PROGRAM - Experience gained during the recently completed Derivative Fighter Comparative Evaluation Program is highly relevant to the planning and flight test phases of the F-4 Modernization Demonstration. Both programs share a common objective, i.e., in-flight validation of predicted performance.

The Comparative Evaluation Program, Contract F33657-81-G-2168, was initiated when the USAF defined a critical need for a Dual Role Fighter with improved range and weapon delivery capability for both air-to-air and air-to-ground operations. Four F-15 aircraft were used during the program which covered the period from 1 November 1982 to 30 April 1983. A total of 204 flights were conducted. One of the aircraft, F-15C AFSN 78-0468, was fully instrumented for performance and flying quality assessment. The program was conducted at Edwards AFB, CA. MCAIR provided engineering, data, instrumentation, and manufacturing support.

Prior to the flight test program, MCAIR data engineers worked closely with on-site USAF data engineers in modifying and validating the data reduction system to be compatible with program needs.



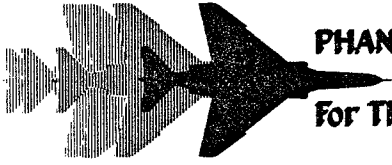
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NUMBER	TITLE	CONTRACT NUMBER	CONTRACT PERIOD	VALUE	USAF CONTRACTING AGENCY
1	Derivative Fighter Comparative Evaluation Program	F33657-81-C-2168-09	11/82 to 4/83	11.1M	USAF
2	Dual Role Fighter	F33657-84-C-2007	4/84 to 8/88	TBD	USAF
3	STOL Fighter Technology Program	F33615-84-C-3015	10/84 to 10/85	117.8M	AFFDL
4	Conformal Fuel Tanks with Tangential Weapons Carriage	F33657-83-C-2133	3/82 to 6/85	19.8M	ASD
5	Radar Equipped AV-8B Design and Avionic System Assessment	N00019-82-G-0460-04	10/83 to 9/85	4.5M	NAVAIR
6	F-4G/APR-38 Performance Update Program	F33657-82-C-0067	10/82 to 4/87	113.4M	ASD/RWW
7	F-4E Wild Weasel Group A Provisions	F42600-75-C-1078	11/74 to 6/82	8.9M	OOALC
8	F-4 Airborne Video Tape Recorder (AVTR)	F42600-77-C-0036	11/77 to 9/82	7.9M	OOALC
9	Planning, Design, Fabrication, and Tests of Subsystem and Equipment for F/A-18/AMRAAM Phase II Integration Program	N00019-82-G-0475-01	4/83 to 2/84	9.9M	NAVAIR

FIGURE 1-1

SUMMARY OF RELEVANT PAST MCAIR CONTRACTS



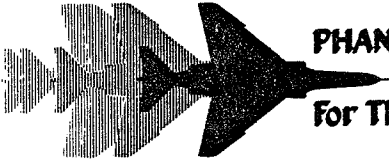
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NUMBER	TITLE	CONTRACT NUMBER	CONTRACT PERIOD	VALUE	CONTRACTING AGENCY
10	Joint Tactical Information Distribution System (JTIDS)	F33657-78-G-0007 F33657-81-C-2168	9/81 to	23.9M	USAF
11	AV-8B Aircraft Systems Device 15C14	N61339-82-C-0016	4/82 to 9/84	3.5M	NTEC
12	F-4D Compass Tie	F42600-77-C-0036	12/77 to 9/82	9.7M	OOALC
13	F-4E Compass Tie	F42600-79-C-0005	3/79 to 3/82	3.4M	OOALC
14	Integrated Flight/Fire Control	F33657-78-C-3601	8/78 to 01/84	16M	AFFDL
15	AFTI-15 Predesign and Preliminary Development of DFCS and HAC	F33615-77-C-0364	7/77 to 1/79	4.7M	USAF
16	Axisymmetric Nozzle Approach and Landing Thrust Reverser Concepts	F33615-80-C-2024	9/8 to 1/84	1.7M	AFWAL
17	NASA F-15 Flight Research Program	NASA-2872	6/81 to 3/84	1.7M	NASA
18	RF-4B Sensor Update and Refurbishment Effort (SURE)	F33657-74-A-0092	6/75 to 8/80	6.5M	NAVAIR

FIGURE 1-1

SUMMARY OF RELEVANT PAST MCAIR CONTRACTS (Continued)



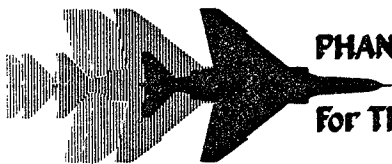
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NUMBER	TITLE	CONTRACT NUMBER	CONTRACT PERIOD	VALUE	CONTRACTING AGENCY
19	F-4E Prototype and Installation of AN/ALR-74 Radar Warning System	N00383-83-G-3500-QP20 N00383-83-G-3500-QP1D	2/83 to 12/84 1/84 to	2.4M 4.4M	00ALC
20	RF-4C Fuel/Antenna Pods for AN/UPD-4 Enhancement Program	F33657-79-C-0414	7/80 to 4/83	3.1M	ASD
21	RF-4C APD-10 Enhancement	N00383-78-A-8504-QPQ7	6/80 to 11/84	6.6M	00ALC
22	F/RF-4 UHF Comm Improvements Program	N00383-81-G-1500-QP7H	9/80 to 9/83	4.6M	00ALC
23	F/RF-4 Parkhill/Vinson Programs	F42600-83-C-4577	10/83 to	7M	00ALC

FIGURE 1-1

SUMMARY OF RELEVANT PAST MCAIR CONTRACTS (Concluded)



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1.1.2 DUAL ROLE FIGHTER - This USAF mission has required improvements to F-15 subsystems through the addition of the radar programmable signal processor (PSP) and the additional fuel package, including low drag CFT's. Further updating of selected avionics equipment is now underway through the F-15 Multi-Stage Improvement Program (MSIP). DRF mission requirements are being met by missionizing the crew stations, improving the targeting capability, and making maximum use of the payload/radius provided by the CFTs. The DRF will be developed with minimum risk and cost, via a joint design, development, and test program with the USAF. This minimum risk is due to the inherent growth of the Eagle's airframe and weapon system coupled with the ongoing development of the F-15. Most notable are the MSIP Phase I and II, the MCAIR Advanced Fighter Capability Demonstrator (AFCD) program, CFT certification, the Digital Flight Control System evaluation, and the AMRAAM integration program. Much of the analyses and development of the DRF has been supported through use of an F-15 cockpit in a MCAIR flight simulator, equipped with the DRF controls and displays, and programmed to simulate flight characteristics and profiles with the CFT's installed. These programs have essentially eliminated technical risk and substantially reduced the development required to attain dual role capability.

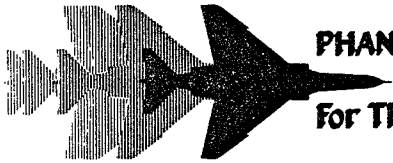
1.1.3 STOL FIGHTER TECHNOLOGY PROGRAM - MCAIR has recently won an Air Force contract to conduct a STOL Fighter Technology Program for the Air Force Flight Dynamics Laboratory (AFFDL). This program will investigate, develop, and validate, through analytical, experimental and flight test methods, those technology areas related to providing current/future high performance fighters with increased performance benefits and STOL capability without undue weight penalty. The key technology areas to be demonstrated in this program are as follows:

- a. Two dimensional thrust vectoring/reversing exhaust nozzle
- b. Integrated flight/propulsion control system
- c. Advanced high lift system
- d. Rough/soft field STOL landing gear
- e. Advanced Pilot/Vehicle Interface (PVI) for STOL operations

The overall objective of this effort is two fold: (1) to individually validate these technologies for other applications; and (2) to integrate these technologies to provide STOL capability to a fighter while improving cruise, maneuver and payload performance.

MCAIR will use a modified F-15 as the demonstrator aircraft for this program. This aircraft will be powered by modified Pratt & Whitney F100 engines coupled with new two-dimensional, thrust vectoring/thrust reversing nozzles.

Although this program is just under way, MCAIR has conducted systems studies and preliminary design with Pratt & Whitney during the proposal period to define the system and predict performance. This effort resulted in the proposal that was selected by the USAF after a spirited competition.



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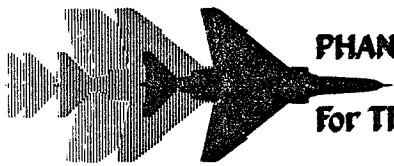
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1.1.4 CONFORMAL FUEL TANKS WITH TANGENTIAL WEAPONS CARRIAGE - This MCAIR program began in 1976 with a plan for the design, development and fabrication of one set of pre-production tanks for flight test purposes. Since that time, continuous MCAIR development and testing has subsequently lead to the current CFT with tangential weapons carriage program. The production CFT's are aerodynamically shaped, non-jettisonable, though removable, external fuel tanks that fit along the sidewall and under the wing of the F-15 air vehicle. Each CFT includes provisions for carriage and launch of tandem mounted air-to-air missiles, as well as provisions for air-to-surface stores and bomb racks. Extensive flight test programs have verified structural integrity, and fuel systems operations, and substantiated that aircraft flying qualities and performance are equivalent to that of an F-15 without the CFT's installed. Aircraft range is increased by 40% with no penalty in payload or flight envelope. Weapons separating/jettison envelopes have also been verified.

1.1.5 RADAR EQUIPPED AV-8B PRELIMINARY DESIGN AND AVIONIC SYSTEM ASSESSMENT - This program is defining and evaluating avionic system changes in a Manned Flight Simulator to assess aircraft radar installation and performance, and the impact on the aircraft and its subsystems. It will also establish optimum design for aircraft controls and display changes through aircrew experience in the simulator cockpit. The study is divided into five tasks.

- o Define the avionic system changes required to integrate the control and display functions of the AN/APG-69 LIASAR (MOD) radar with the AV-8B modes, controls and displays. Functions will be allocated to the radar or other subsystems to establish hardware/software requirements. A Display Interface Unit (DIU) will be defined and developed and the AV-8B mission computer flight program modules will be modified to operate with the radar and DIU.
- o Define the main instrument panel rearrangement for the addition of the radar display. A radar control switch will be incorporated into the sensor control panel.
- o The flight hardware Manned Flight Simulator will be modified to incorporate the second Multipurpose Display in the main instrument panel. Software will be prepared to simulate radar operation.
- o A one week USN/USMC manned flight simulation program will assess the capability of the radar equipped AV-8B to perform air-to-air and air-to-ground Navy missions. System change recommendations will be documented.
- o Preliminary design of the radar installation in the AV-8B will be performed. This design will include layout drawings and an analytical assessment of the impact of the radar on the aircraft structure and subsystems.

1.1.6 F-4G/APR-38 PERFORMANCE UPDATE PROGRAM (PUP) - MCAIR is currently working on the F-4G/APR-38 (PUP) program to develop and produce AN/APR-38 system improvements which will enable the F-4G Wild Weasel aircraft to operate effectively in the 1985 to 1995 time frame.



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1.1.6 (Continued)

The program is in two phases. Phase I increases the computer memory and processing capability to accommodate an improved operational flight program (OFF) and added BIT diagnostics. This is accomplished by replacing the present AN/APR-38 HAWC with a new computer, the Weasel Attack Signal Processor (WASP) which has substantially larger memory and much faster processing capability than the HAWC within the same envelope. This requires interfacing the WASP with previously developed hardware in the existing APR-38 system. Two prototype and ten preproduction WASP units are being designed and fabricated under subcontract to Sperry Defense Systems. Extensive integration, reliability, maintainability, qualification and airworthiness testing will be performed. MCAIR will support the USAF Flight test program.

Phase II of the program will provide the current APR-38 system with frequency extensions, component updates, new threat capability and future threat interface through the development of a new Directional Receiver Group (DRG) and Low Frequency Synthesizer (LFS). An updated Operational Flight Program is also being developed by MCAIR. The design and fabrication of one DRG engineering model and eight preproduction units are being performed by E-Systems under a subcontract from MCAIR. This equipment will also undergo extensive integration, reliability, maintainability, qualification and airworthiness testing as well as flight testing.

A recent contract addition was received to integrate the ARN-101 Inertial Navigation System with the F-4G/APR-38 PUP equipment and to upgrade the Phase II OFF Program 1009 to Program 4000.

MCAIR has recently submitted a proposal for furnishing production quantities of the WASP and WASP support equipment. This program is a follow-on to the Phase I portion of the F-4G/APR-38 PUP FSED Contract F33657-82-C-0067, and runs concurrently with the completion of Phase I testing and the continuing Phase II FSED.

1.1.7 F-4E WILD WEASEL GROUP A PROVISIONS - MCAIR provided the engineering design and development for the retrofit installation of the AN/APR-38 Advanced Wild Weasel into F-4E aircraft, including AGM-78 Standard Arm and AGM-45A Advanced Shrike capabilities. The AN/APR-38 included the special warning receiver (SWR), modular central power supply unit (CPSU), increased HAWC memory, and the mission recorder reproducer. Removed were the M61A1 gun system, direct reading scope camera, and the AN/APR-36/37 (or AN/ALR-46) RHAW system. RHAW provisions were retained except as they interfered with AN/APR-38 installation.

Extensive modifications were made to the exterior of the aircraft, including new forward fuselage chin pod, A.I. radome, and fin pod. The vertical fin was modified to accept the new pod. Extensive modifications were also made to the interior of the aircraft. These included major changes to the forward and aft cockpits. Avionics shelves were installed in the space made available by the removal of the M61A1 gun, and cooling air ducts were rerouted. New wire bundles were added in the radome, nose, cockpits, vertical fin, and forward, center, and aft fuselages.



1.1.7 (Continued)

MCAIR installed the Group A provisions in an F-4E and performed a trial installation and ground functional test. Two check flights were made in St. Louis for aircraft shakedown, to perform in-flight EMI checks and to verify proper function of the AN/APR-38 system.

The first modified F-4E was flight tested in 1976 at NWC China Lake and Nellis AFB ranges. All goals of the modification/update programs were demonstrated. The second F-4E was modified and one check flight was made with AN/APR-38 pilot production equipment installed prior to its delivery to Hill AFB.

1.1.8 F-4 AIRBORNE VIDEO TAPE RECORDER (AVTR) - The Airborne Video Tape Recorder (AVTR) is a manually operated recording system on which in-flight video and audio information can be retained on magnetic tape for post flight evaluation. The system continuously records all raster video being displayed on the aft radar indicator and all audible signals present in aircrew headsets. OOALC procured TEAC V1000AB-R video cassette AVTR's for installation in RF-4C, F-4D, F-4E, and F-4G aircraft.

MCAIR provided engineering effort to design the installation and the Group A kits, performed a trial installation on each F-4 model, and provided Group A kits. Functional ground tests were performed to assure proper operation of the AVTR and associated equipment. Each aircraft was given a check flight before delivery.

1.1.9 F/A-18/AMRAAM PHASE II INTEGRATION PROGRAM - MCAIR will perform NAVAIR directed tasks to accomplish the planning, design, fabrication and tests of subsystems and equipment for F/A-18/AMRAAM integration program.

1.1.10 JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM - JTIDS is a secure jam resistant data link between airborne warning and control centers, other aircraft, Army ground sites, and numerous other contributors. The JTIDS Class II terminal which MCAIR is integrating into the F-15 will provide the crew with a total awareness of both the airborne and ground environment within 320nm of the aircraft. MCAIR's integration of the JTIDS terminal with the new F-15 multipurpose color display provides a color presentation of friendly, hostile, and undefined aircraft, reference lines, waypoints, safe passage corridors, hostile ground sites, alternative landing strips, and targets detected by other JTIDS contributors.

An additional capability provided by JTIDS is relative navigation, which is inherent in its design. When JTIDS is operating with other JTIDS terminals on location, the onboard JTIDS can provide a navigation capability that is unaffected by drift and is more accurate than the onboard inertial navigation system. Further, the F-15 JTIDS terminal will perform all functions previously performed by the ARN-118 TACAN. MCAIR is integrating the JTIDS Class II terminal with the subsystems previously integrated with TACAN, such as the cockpit displays subsystem and the navigation aids control.



1.1.11 AV-8B OPERATIONAL FLIGHT TRAINER (OFT) - This is the most recent of a series of manned aircraft flight simulation systems designed and built by MCAIR to provide pilot training. The system features an AV-8B cockpit representative in all respects of the actual aircraft, including functioning controls and displays and simulated g-loads and aircraft sounds.

Simulators of this type are regularly used by MCAIR as a tool in system design through the use of cockpit and displays, and evaluation of flight performance through computer modeling. The F-15, F-18, and AV-8B were "flown" extensively in simulation before the first actual flight of the aircraft.

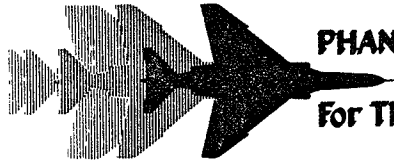
The OFT provides pilot training utilizing a full visual scene by means of a computer image generation system to provide terrain and environmental features, ground and sea bases, field operational site, ski-jump runway system, and the USS Guam, USS Shreveport, USS Tarawa, and the USS Nimitz. Vertical Takeoff/Landing, Rolling Vertical Takeoff/Landing, Ski-Jump Takeoff, Short and Conventional Takeoff/ Landing, Emergency or degraded operations, and Navigation/Communications make up the training curriculum.

AV-8 Weapons Tactics Trainer (WTT) - The WTT provides Aircrew Training in Air-to-Ground Weapons delivery, Air-to-Air Weapons delivery, Visual Tactics, Navigation, ECM, and missions with system malfunctions or degraded operations. The WTT retains the same cockpit and flight hardware as the OFT, but does not have aircraft ground handling software.

1.1.12 F-4D COMPASS TIE - MCAIR performed the engineering design and development for the Group A installation of the AN/ALR-69 into F-4D aircraft and provided kits for trial installation and kit proof. This process used design and development information from the F-4D Compass Tie prototype installation, accomplished by MCAIR under an earlier contract. The modification removed the AN/APS-107 Radar Receiving Set. Production Group A kits and Group B hardware were provided by the government.

The process required extensive antenna installation, avionics installation and integration, EMI testing and integration bench testing. MCAIR performed ground tests to ensure system compatibility. These included: bench functional tests using a USAF fabricated interconnect harness, to check the AN/ALR-69 system, alignment and interface with other onboard avionics prior to the installation; sweep frequency measurements of the extended frequency cables; ramp installation/functional tests of the AN/ALR-69 installed, consisting of system checkout and EMC "walk-around"; ramp coaxial cables, including RF coaxial cable sweep frequency measurements.

Flight tests were performed on the trial installation aircraft at MCAIR to accomplish aircraft functional checks and verify the suitability of MCAIR Group A installation provisions.



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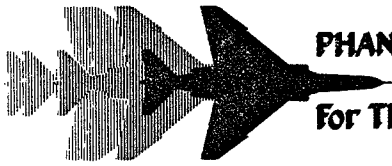
1.1.13 F-4E COMPASS TIE - MCAIR performed the engineering design and development for Group A installation of the AN/ALR-69 into F-4E aircraft, provided kits for a trial installation and kit proof, and supplied Group A kits for the F-4E retrofit. The Group B equipment was GFE. To ensure system compatibility, MCAIR performed the following ground tests: bench functional tests using a USAF fabricated interconnect harness, to check the AN/ALR-69 system, alignment, and interface with other on-board avionics; sweep frequency measurements of CFE AN/ALR-69 extended frequency cables; ramp installation/functional tests of the AN/ALR-69 installed in the aircraft, consisting of system checkout and EMC "walk-around"; ramp coaxial cable installation tests of the extended frequency coaxial cables, including RF coaxial cable sweep frequency measurements; laboratory vibration tests of the AM-6971/ALR Amplifier Detector installation to determine the effectiveness of the isolation system. A dummy box was installed that simulated the amplifier detector mass, c.g., and inertia properties.

Ground tests were successfully completed and one flight was made for aircraft functional checks and to verify suitability of the Group A provisions. This program was subsequently cancelled by the USAF and replaced with the ALR-74 program.

1.1.14 INTEGRATED FLIGHT/FIRE CONTROL - IFFC is a pilot-aided system for the delivery of unguided weapons which allows information from the fire control system to be blended with pilot inputs to the flight control systems, leading to improved weapon delivery and greater survivability. The AFFDL IFFC program encompassed extensive hardware and software changes to the F-15 flight control system and weapon control system, via Class II modification. The Air Force-conducted flight test demonstrated integrated flight/fire control technology as applied to air-to-air gunnery, air-to-surface gunnery, and bombing. Also demonstrated during IFFC flight test was the integration of the fire control system with a Digital Electronic Flight Control System (DEFCS). The DEFCS was developed by MCAIR as an Independent Research and Development program. The digital computers controlling the flight control system were programmed with a higher order language.

1.1.15 AFTI-15 PREDESIGN AND PRELIMINARY DEVELOPMENT OF DFCS AND HAC - The Advanced Fighter Technology Integration (AFTI) program was conducted to provide advanced development of integrated technologies through the flight demonstration phase. Under this contract MCAIR performed the Phase I design definition of a modification of an F-15 to serve as a flight demonstrator. In addition to the AFTI-15 definition, two additional separate developmental efforts were accomplished: a digital flight control system task and a high acceleration cockpit task. This program involved extensive simulation investigations of uncoupled motion capability. Studies of controller configuration, and controller/display concepts were included in this effort.

1.1.16 AXISYMMETRIC NOZZLE APPROACH AND LANDING THRUST REVERSER CONCEPTS - The overall objectives of this program were to identify the potential benefits of axisymmetric nozzle approach and landing thrust reversers (ALTR), and develop the technical data base required to validate their feasibility and performance characteristics.



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In Phase I of the program, analytical assessments were made of the ALTR impact on the airframe and engine-related characteristics of both a current fighter (the F-15C) and an advanced air-to-surface (ATS) fighter. A total of three ALTR concepts, two for the F-15 and one for the ATS, were evaluated.

Phase II of the ALTR program consisted of a series of experimental evaluations of the three chosen concepts. Static tests were conducted to assess the baseline internal performance of the ALTR concepts and the effect of various design parameters. Low speed wind tunnel testing provided the installed characteristics of the designs at both in-ground effects (IGE) and out-of-ground effects (OGE) conditions.

The results of this program showed that through proper ALTR design and integration, it is possible to achieve a near balanced-field length capability independent of runway conditions. In addition, it was shown that with proper ALTR design and integration, performance penalties in terms of aerodynamic interactions, mission radius, maneuverability, weight, engine usage and system life cycle costs were small.

1.1.17 NASA F-15 FLIGHT RESEARCH PROGRAM SUPPORT - This program involves the flight testing of two F-15 aircraft loaned to NASA by the Air Force. The flight program was conducted at the Dryden Flight Research Center (DRFC), Edwards AFB, CA. The aircraft was maintained and operated with MCAIR support. MCAIR has provided consultation for instrumentation, aircraft modification, and engineering.

1.1.18 RF-4B SENSOR UPDATE AND REFURBISHMENT EFFORT (SURE) - In 1975 MCAIR was authorized to proceed with this program which required the design and development for the Group A installation, for the integration and installation of four new avionic systems; inertial navigation system, air-to-ground data link, side looking airborne radar, and the infrared reconnaissance set. Major changes were incorporated into the main instrument panels of both cockpits, and extensive structural and electrical changes were made to accommodate the new hardware and substantial studies were performed to ensure/control interface compatibility among the airborne systems and with the aircraft. Flight testing was held to a minimum. Only seven flights were required to verify system functional operation.

1.1.19 F-4E AN/ALR-74 RADAR WARNING SYSTEM (RWS) - MCAIR is expending maximum effort for the removal of the AN/ALR-46 RWS from the F-4E aircraft and replacement by the AN/ALR-74 RWS. MCAIR will perform the necessary engineering, development, and testing for Group A provisions to integrate the AN/ALR-74 system into the F-4E. This is a follow-on to the F-4E/ALR-74 Prototype effort which successfully integrated and installed the prototype ALR-74 system into an F-4E aircraft which was then flight evaluated by USAF during a 12 month period. MCAIR will provide Group A kits for a trial installation, kit proof, and retrofit. The Group A provisions will be compatible with the Group B equipment supplied as Government Furnished Equipment (GFE). The Group B equipment will be an Azimuth Indicator, Indicator Control, Amplifier-Detectors and Antennas, Signal-Processor, FMRS Controller/Receiver/Antenna Switch, Low



1.1.19 (Continued)

Band Antenna Assembly and Receiver, and Transmission Line Coupler. Extensive modifications (i.e., structure modifications to the forward and center fuselage and wing; equipment changes in the forward, center and aft fuselage; electrical changes) will be accomplished to accommodate the AN/ALR-74 RWS.

To ensure system compatibility, MCAIR will perform the following ground tests: a bench functional Test to check AN/ALR-74 system alignment and interface with other onboard avionics; a ramp installation/functional test on the AN/ALR-74 system installed in the aircraft, including system operational checkout and EMC "walk-around" test; a pin-to-pin wiring check on the validation aircraft prior to installation of Group B equipment; sweep frequency measurements on new CFE AN/ALR-74 extended frequency cables; a ramp coaxial cable installation test for extended coaxial cables, including RF coaxial sweep frequency measurements. Following the ground tests, one flight test will be flown for basic aircraft functional checks and to verify suitability of the Group A provisions.

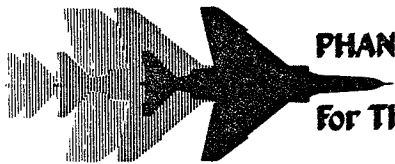
1.1.20 RF-4C FUEL/ANTENNA PODS FOR AN/UPD-4 ENHANCEMENT PROGRAM - This MCAIR program ran concurrent with the RF-4C APD-10 Enhancement program, and required the design, fabrication and test of nine new AN/UPD-4 Radar Reconnaissance System Centerline Station Fuel/Antenna Pods plus installation and checkout of the Group B. These pods were designed to be fully compatible with the Group B extended range antenna assembly which was provided by Goodyear Aerospace Corporation, and at the same time, interface with the requirements of APD-10 Enhancement Program.

1.1.21 RF-4C APD-10 ENHANCEMENT - MCAIR performed the engineering design and development for the Group A installation required to modify 12 RF-4C aircraft equipped with APD-10 and 6 RF-4C aircraft without APD-10 to include provisioning for the APD-12 Radar, extended range pod and a data link capability. In addition, MCAIR was required to supply a trial installation kit, perform complete trial installation and testing at MCAIR.

Modification to the aircraft required a newly designed data link radome, installation of 20 new units and attendant wiring changes and addition of new waveguides.

Ground tests were successfully completed and MCAIR supported USAF flight testing at Luke AFB, AZ.

1.1.22 F/RF-4 UHF COMM IMPROVEMENTS - MCAIR solicited and was subsequently awarded a contract to design, develop and demonstrate an improvement program, with Group A kits, to: (1) Change F/RF-4 UHF Comm Subsystem to provide radio communication ranges out to maximum line-of-sight distances, (2) Provide a second UHF radio receiver, (3) Provide emergency/battery UHF radio communications, and (4) Add static dischargers to the aircraft. Without changing or modifying any of the functional units within the subsystem, the objectives of the task were accomplished. Major changes were made in aircraft wiring/subsystem control logic and the RF portion of the subsystem was completely



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replaced with new coaxial cables and antennas were relocated. The demonstration was accomplished by a contractor team deployed to three separate USAF facilities, modifying an aircraft, realigning subsystem units on the field level benches and supporting USAF flight testing which successfully validated all of the program requirements.

1.1.23 F/RF-4 PARKHILL AND VINSON PROGRAMS - A currently in-progress activity is the integration of VINSON (UHF Secure Speech) into the F-4E/G UHF Comm Subsystem and both the PARKHILL (HF Secure Speech) and VINSON Systems into the RF-4C. The program encompasses significant changes in both the HF and UHF Radio subsystems and aircraft intercommunications subsystem including design, development, qualification and production of new functional interface units and complete Group A retrofit kits. MCAIR Avionics Laboratory was used to verify and improve the initial design concept. Forthcoming portions of the program will include design, development and delivery of attendant changes to the field level test benches necessary to support the new subsystem configuration. MCAIR has responsibility for the modification, checkout and flight testing of the RF-4C aircraft and will deploy a field team to USAF facilities for the modification, checkout, and support of the USAF flight tests on the F-4E/G aircraft.