



United States Air Force



Air Force Aerial Targets

“Preparing for the New Threat”



3 October 2002

40th Annual NDIA Air Targets,
UAVs Range Operations Symposium

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Director, Aerial Targets SPO
Eglin AFB, FL

Overall Classification of This Briefing
is Unclassified



Overview



- **Background**
- **Product Groups**
 - Full Scale Aerial Targets
 - Subscale Aerial Targets
 - Target Control Systems
 - Target Payloads
- **The Way Ahead**



Purpose



WMRA

- **Aerial Targets Program Management Directive:**
 - **“Aerial targets are required for both development and operational testing of weapons systems. Title 10 United States Code 2366 requires all new or improved weapon systems demonstrate their lethality prior to production. Aerial targets and the missile scoring systems carried on-board are the mechanism to demonstrate that lethality. In addition, fielded weapons systems undergo continual evaluation under the USAF Air-to-Air Weapon System Evaluation Program (WSEP).”**
- **Aerial targets are also used for evaluation/training exercises such as WILLIAM TELL.**



Background



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- **The entire Air Force Aerial Targets team provides**
 - **Realistic threat-representative aircraft “presentations”**
 - **The target itself**
 - **The ability to control the target in the air**
 - **Launch, recovery, maintenance, repair**
- **The Aerial Targets System Program Office**
 - **Develops, procures and sustains aerial targets and related systems**



Program Description



WMRA

- **We support:**
 - Developmental test
 - Operational test
 - Operational evaluation
 - Exercises (e.g., WILLIAM TELL)
 - Training
- **We operate at:**
 - Tyndall AFB, FL
 - Eglin Gulf Range
 - Holloman AFB, NM
 - White Sands Missile Range (WSMR)



Who Are Our Customers?



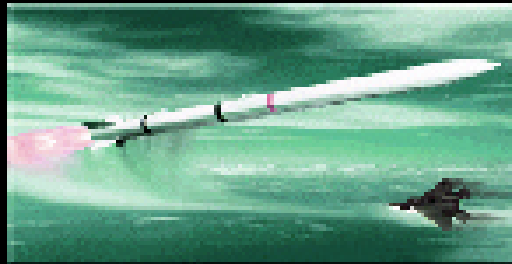
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Missile development programs ... and testers !!!

AMRAAM

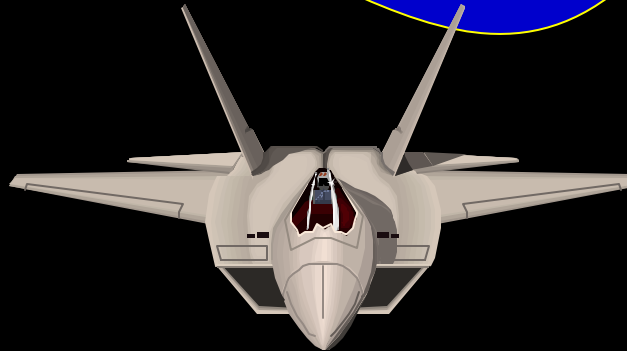


ASRAAM



SPECIAL PROGRAMS

AERIAL TARGETS



Shooters...

Operators...

Maintainers...



Where We Fit In



WMPA

Headquarters Air Force

Air Combat Command

Air Education & Training Command

Air Force Reserve Command

Air Force Space Command

Air Force Materiel Command

Air Force Special Operations Command

Air Mobility Command

Pacific Air Forces

US Air Forces Europe

Laboratories

Test Centers

Product Centers

Air Logistics Centers

Specialized Centers

Air Force Research Laboratory

Arnold Engineering Dev Center

Electronic Systems Center

Ogden ALC

Aerospace Maintenance & Regeneration Ctr

Air Force Office of Scientific Research

Air Force Flight Test Center

Aeronautical Systems Center

Oklahoma City

Air Force Security Assistance Center

Air Armament Center

Warner Robins ALC



Aerial Targets Organizations



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Program Manager: 1Lt Gabe Hiley
Lead Engineer: Mr. Glenn Ragsdale



QF-4

**Full Scale Aerial
Targets
(FSAT)**





FSAT – Where Are We Now?



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- Description:**
- Retired F-4E/G Aircraft Reinstated by AMARC
 - Converted to Remote-Controlled Target
 - Large Payload Capability for ECM
 - Supports Live Fire / Lethality Testing (Title X)

Contractor: BAE Systems, Mojave CA

Contract Type: FFP

Acquisition Phase: Production /
Sustainment

Joint: Air Force / Army / FMS

Operating Ranges: Eglin Gulf Range &
White Sands Missile Range (WSMR)



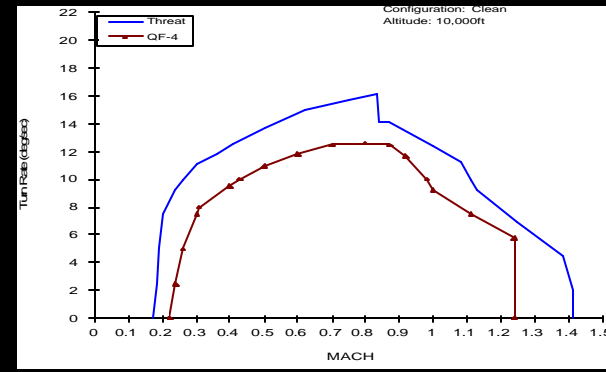
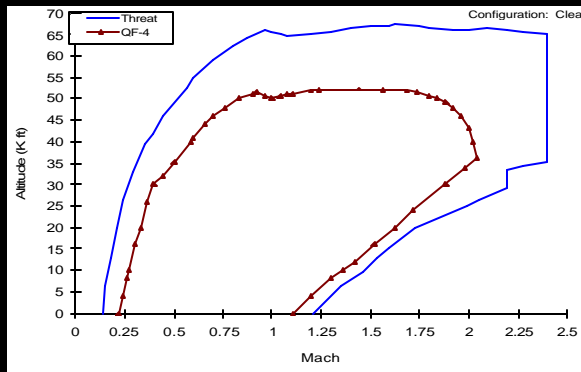


QF-4 Limitations



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- Not representative of 4th- or projected 5th-generation threats (fighters)



- QF-4s are not interoperable across multiple Service T&E ranges
- Expect increasing supportability issues in the 2007-2010 timeframe



FSAT – Where Are We Going?



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- **Air Superiority Target (AST)**
 - Follow-on to QF-4, first true tri-service FSAT
 - IOC required FY 10 (draft ORD)
 - Will better represent 4th or 5th generation fighter aircraft
 - Cost estimate provided to ACC for FY04 POM

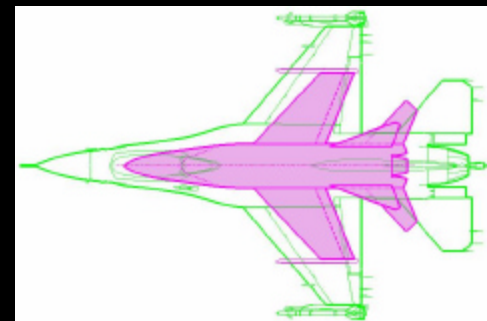


AST Requirements



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- **Draft “joint interest” ORD:**
 - Produce sufficient targets to support DoD requirements from FY11 through FY25
 - Annual kill rate of 25 ASTs
 - Total anticipated buy of 375 drones
- **Must operate at multiple locations:**
 - Tyndall AFB, FL / Eglin Gulf Range
 - Holloman AFB, NM / White Sands Missile Range
 - NAWC China Lake ,CA
 - Point Mugu, CA





AST TMI



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- **PRDA released to Industry – Jul 01**
- **Contractors to identify solutions to meet AST ORD requirements**
 - **Airframe**
 - **Retired Military Aircraft**
 - **Foreign Aircraft**
 - **UAVs**
 - **Other than Existing Aircraft**
 - **Manned or Unmanned**
 - **Presentations**
 - **Mobile Range Concept**
 - **Ground and/or air launch**
 - **Re-configurable vehicles**



AST TMI Concept Studies



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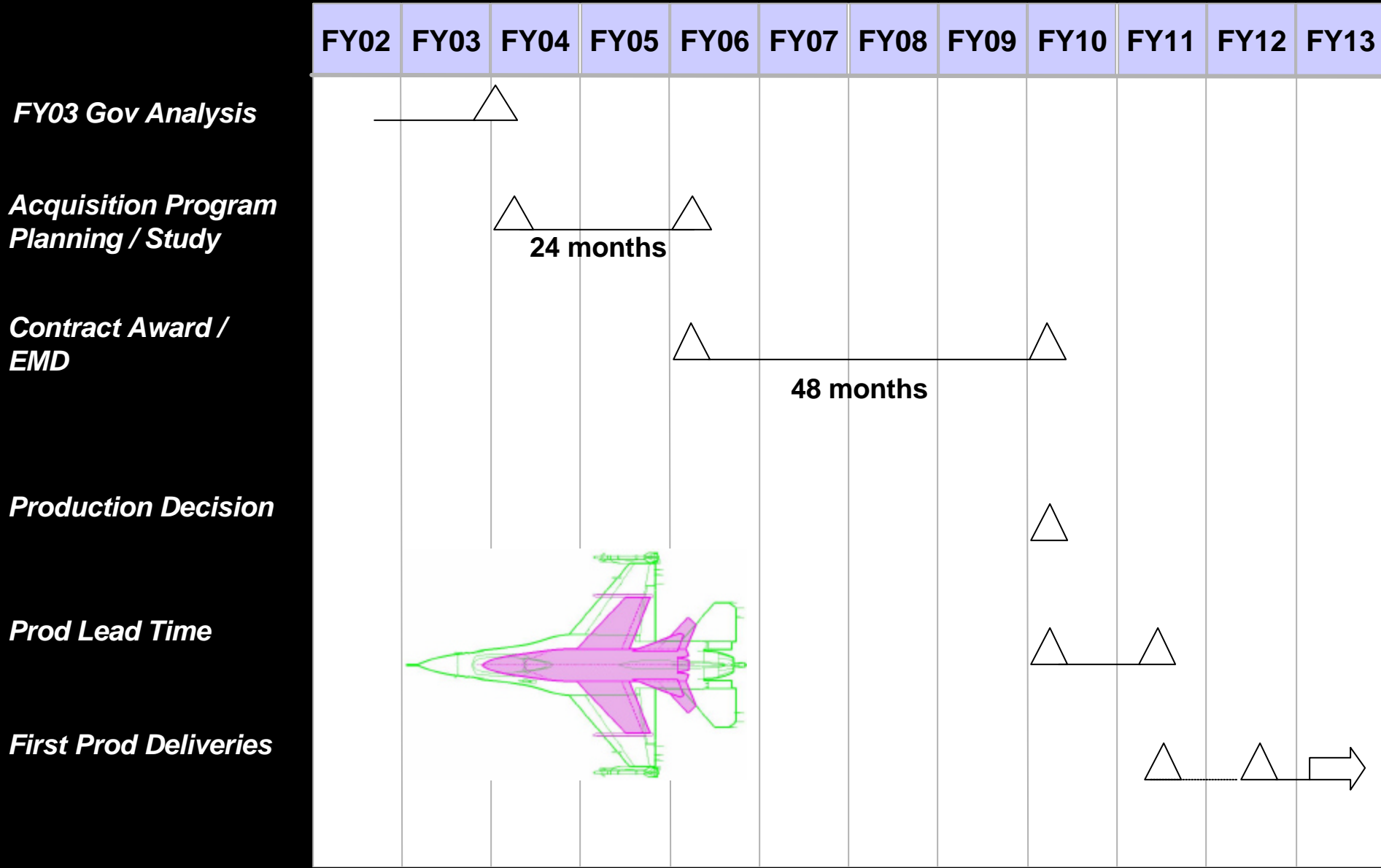
- **Three contracts awarded in Sep 01:**
 - **Lockheed Martin Corporation
Palmdale CA**
 - **Lockheed Martin Corporation
Fort Worth TX**
 - **The Boeing Company
Military Aircraft and Missile Systems
St Louis MO**



Notional AST Schedule



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MQM 107

Program Manager: Lt Paul Claveloux
Lead Engineer: Mr. John Goleta



Subscale Aerial Targets



AFSAT

Program Manager: Elaine Farrington
Lead Engineer: Mr. Joel Knight

BQM 34-A

Program Manager: 2Lt Keith Larson
Lead Engineer: Mr. John Goleta



BQM-34



Program Manager: Lt Keith Larson
Systems Engineer: Mr. John Goleta



BQM-34A

Where Are We Now?



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Description:

- ➔ More survivable (than QF-4)
- ➔ Less expensive
- ➔ High-G maneuvers (vs MQM-107)
- ➔ Highly maneuverable
- ➔ High-altitude flight
- ➔ Transonic speeds
- ➔ Carry heavy EA/ECM
- ➔ Proportional control (-53)
- ➔ Advanced maneuvers (-53)
- ➔ Operation down to 50 feet (-53) w/ RALACS
- ➔ Factory-installed scoring subsystem/hardware for payloads

BQM-34A



- Contractor: Northrop-Grumman Ryan Aeronautical Center
- Acquisition Phase: Production/Deployment/Sustainment
- Used by: Army/Navy/Air Force

MQM-107 SUSTAINMENT



Program Manager: Lt Paul Claveloux
Systems Engineer: Mr. John Goleta



MQM-107 Program Sustainment Effort



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Description: Subscale aerial target



- ➔ More survivable (than full scales)
- ➔ Less expensive
- ➔ Highly maneuverable frequently augmented with IR pods

Target Inventory: MQM-107D (Raytheon)
MQM-107E (BAE)

Sustainment Contractor: BAE Flight Systems

Contract Type: Fixed price--time and materials

Acquisition Phase: Sustainment

Used by: Army/Air Force





Air Force Subscale Aerial Target (AFSAT)

**Program Manager: Elaine Farrington
Systems Engineer: Mr. Joel Knight**



AFSAT



WMRA

- **What We Need**
- **AFSAT Direction**
- **AFSAT Contract Award**
- **Operational Benefits**
- **Unique Features**
- **Top Level AFSAT Schedule**
- **Potential AFSAT Future**





What We Need



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- **Single multi-mission subscale aerial target to satisfy infrared and electronic attack missions.**
- **Affordable multi-mission capability**
- **Fix shortfall in subscale inventories (FY06)**
- **Provide capability for future growth**



AFSAT Key Requirements



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	Threshold/Objective
• Payload weight (lbs)	
– Total (wings)	300/500
– Internal	100/350
• Endurance/Mission time (min)	
– Total	60/75
– Mil Power	30 of 60 (@ 15k ft) / 45 of 75 (@ 500 ft)
• Airspeed (@15kft)	
– Minimum	250 KCAS/200 KCAS
– Maximum	0.90M / 1.5M
• Formation flights 2, 3, and 4 targets	



AFSAT Contract Award



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- **Contract awarded 12 July 02 to Composite Engineering Inc (CEi)**
 - CEi name for new target: “Skeeter”
 - Herley Vega - avionics
 - MicroTurbo - engine
 - Boeing - guidance and control
 - Irvin – recovery system
 - ATK - RATO





Operational Benefits



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- **Design meets/exceeds payload objectives**
 - Internal Weight Capacity = 350 lbs (350 lbs)
 - Wing (each) Weight Capacity = 300 lbs (250 lbs)
- **Meets low airspeed objective; 200 KCAS @ 15,000 ft**
- **Meets/exceeds all key performance parameters (KPP)**



Unique Features



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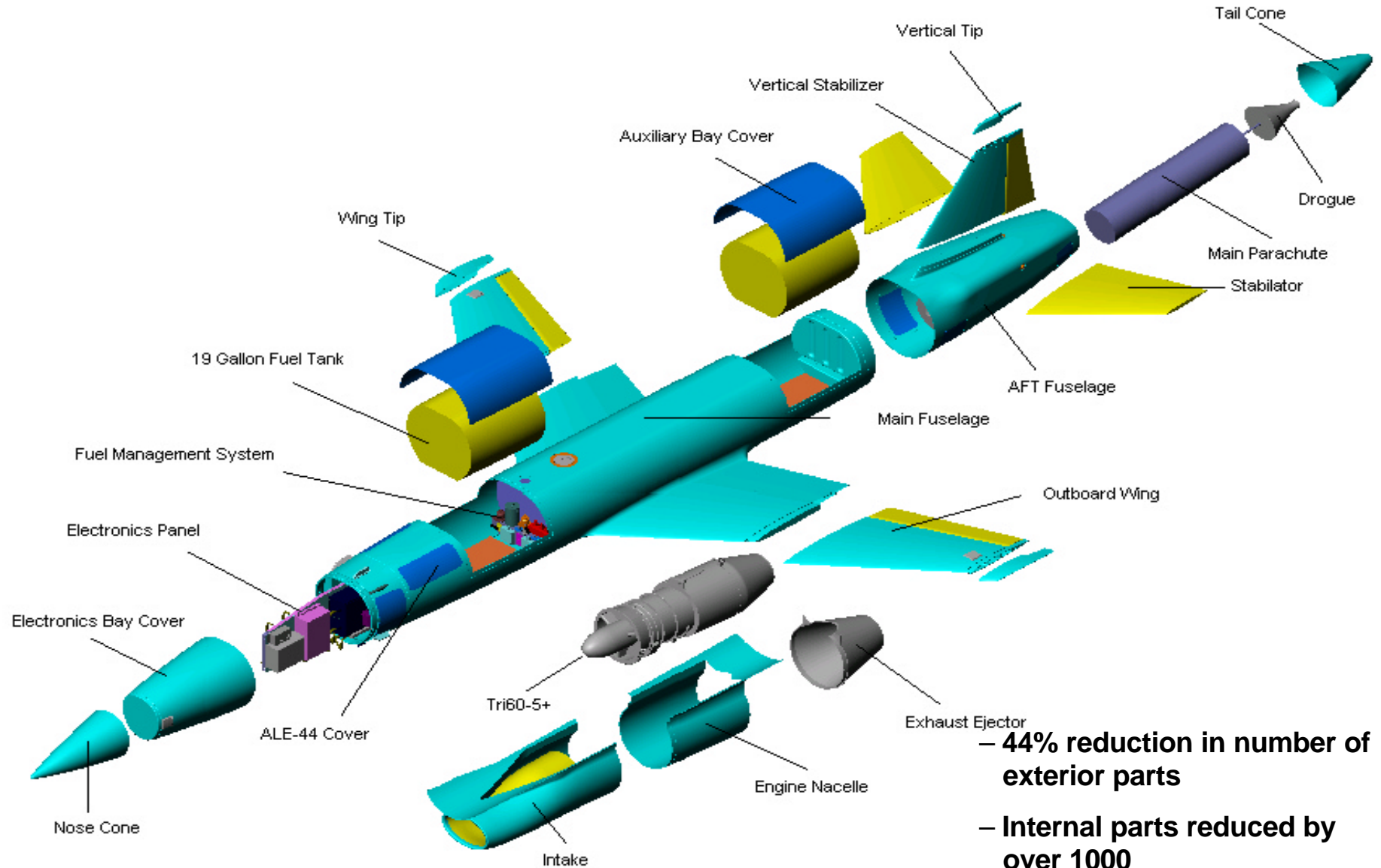
- **New airframe design—all composite**
 - High strength and stiffness to weight ratio
 - Corrosion resistant
 - Airframe can support growth initiatives for KPPs
- **Repairs and Maintenance**
 - 44% reduction in number of exterior parts
 - Internal parts reduced by over 1000
 - Minor damage is field repairable
 - Modular design offers easy access



Unique Features (cont)



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Potential AFSAT Future



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- Meets Air Force requirements and potential multi-service use
- Improvements to address:
 - Multi-service Target Control System (MSTCS)
 - Enhanced engine for speed/endurance
 - Signature
 - Internalized Electronic Attack systems
 - Air launch capable



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Program Manager: Mr. Everett Eblen
Lead Engineer: Mr. Jim Lefebvre



Target Control Systems (TCS)





Target Control Systems



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- **Gulf Range Drone Control System (GRDCS)**
- **Multi Service Target Control System (MSTCS)**



GRDCS



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- **Current range system, used to track/control targets, weapons, other airborne assets**
- **Functional at the Eglin Gulf Range (includes Eglin AFB and Tyndall AFB)**
- **Slightly different version also functional at White Sands Missile Range (WSMR)**
- **Operational since early 80's**



GRDCS Description



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Capability to Track

- Control 4 drones, any mix of: QF-4, BQM-34A, MQM-107D/E
- 4 shooters
- Terminate 4 missiles
- 4 high fliers
- 2 other aircraft

Assets

- 8 consoles
- 14 ground stations
- 15 tracking pods plus spares
- 2 GRDCS Mobile Control Systems (Tyndall & Holloman)



GRDCS Limitations



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- **Access and reliability of 915 MHz data-link**
 - Commercial interference
 - Spectrum sell-off
- **Not deployable**
 - No GPS
 - Requires multi-lateration
- **Lack of secure operations**

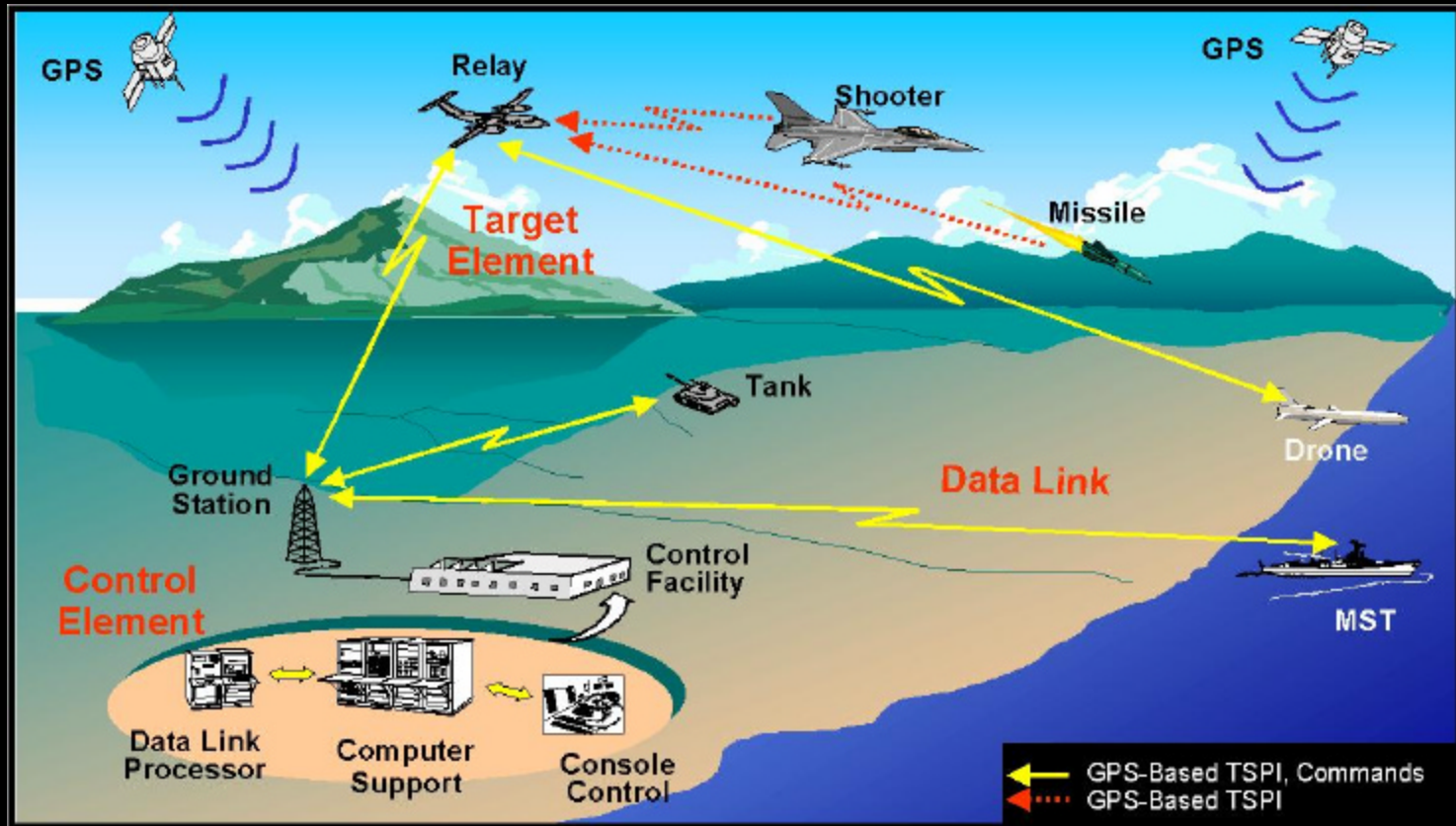


MSTCS Program Description



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Provide an interoperable suite of equipment and software for use within the Department of Defense for command and control of the various target systems





MSTCS Demonstration



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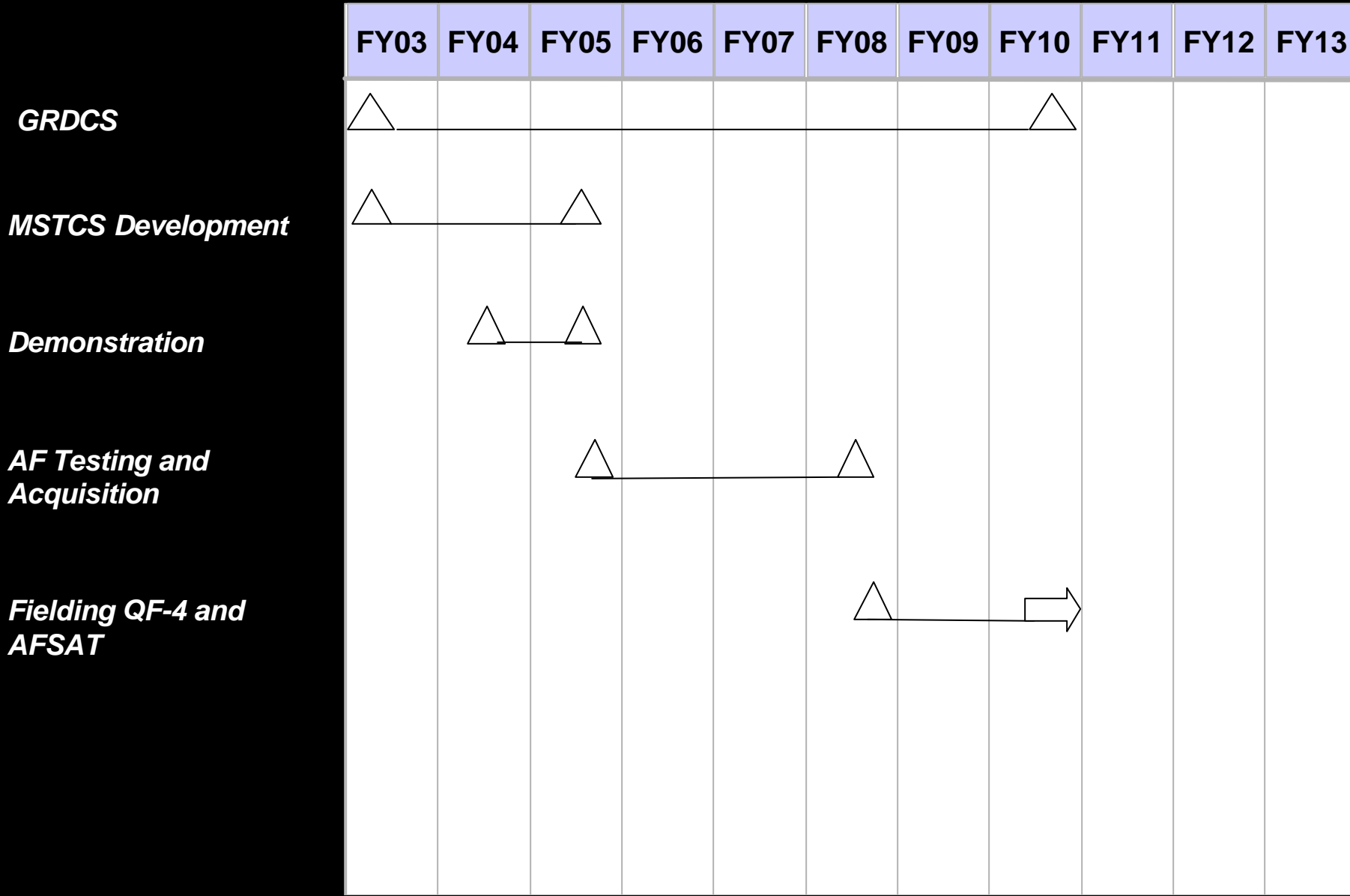
- **OSD-funded CTEIP program to upgrade system**
- **MSTCS concept demo, managed by 46th TW**
 - **Develop / build transponder and control software interface**
 - **Create new software and hardware vehicle interface**
 - **Demo completed by FY 05**



Target Control Systems Schedule



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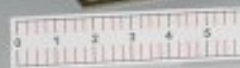
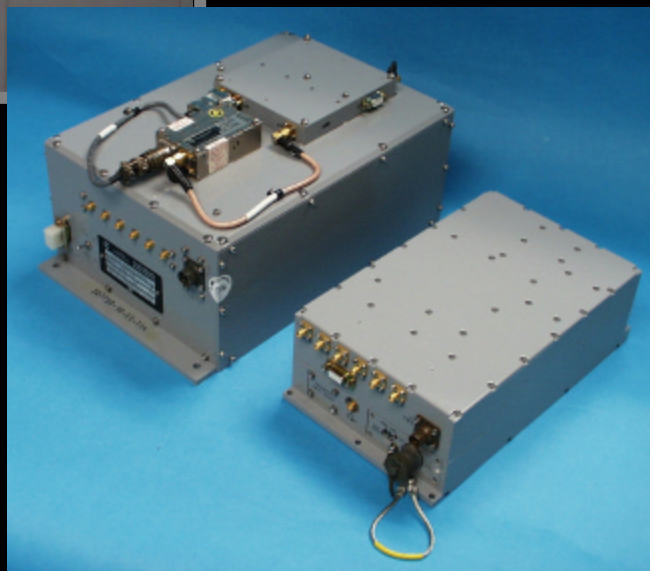


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Program Manager: MSgt Wes Fenton
Lead Engineer: Mr. Ernest Finney



Target Payload Systems





System Information



WMRA

Mission: Enhance combat readiness through use of electronic attack (EA) simulators that enable aerial targets to better represent real-world threats

Key Players: **Naval Air Warfare Center (NAWC)**

- Provide LRUs for DLQ-9s and ALQ-188s
- Builds DLQ-9s

WR-ALC/LNXB

- Sustainment support for ALQ-188s

Quick Reaction Capability (QRC)--Northrop Grumman--Rolling Meadows IL

- Pod integration, sustainment

Existing Systems: AN/ALQ-188B, DLQ-9



Payloads – Where are we now?



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AN/ALQ-188B

DLQ-9

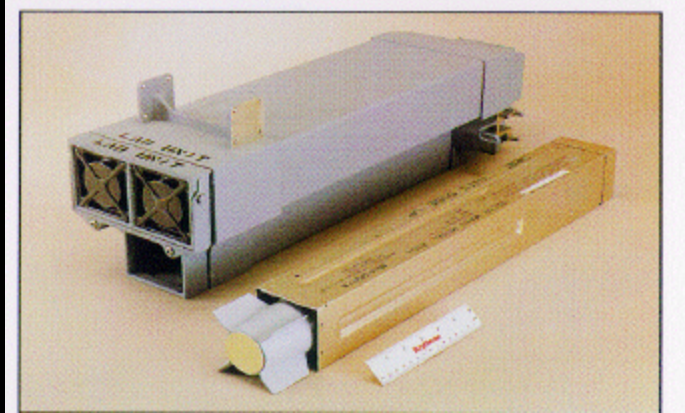




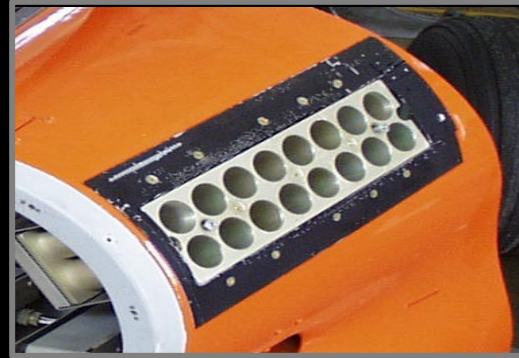
Payloads— Where are we now?



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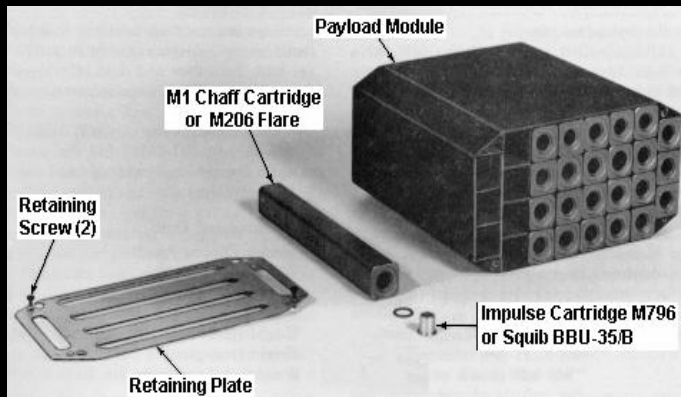
ALE-50



ALE -44



APC-4



M-130



ALE-40



Payloads- Where are we going?



WMRA

- **Miniaturization**
 - Integrate current EA payload LRUs for internal carriage on subscales
 - Encourage miniaturization of EA radar into AFSAT production at earliest opportunity
- **Other EA enhancements**
 - Keep pace with ability to represent threats
 - Analog / digital signal processing enhancements
 - Threat-driven and non-threat-driven
- **Internalized chaff/flare on AFSAT**
 - Integration of ALE-47

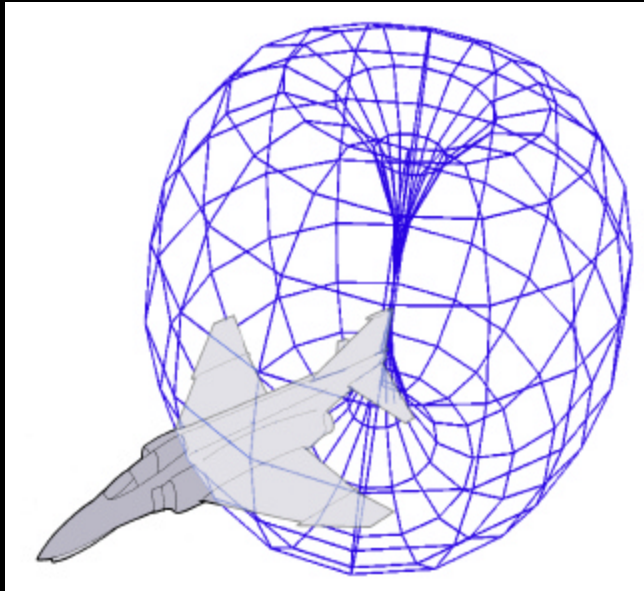
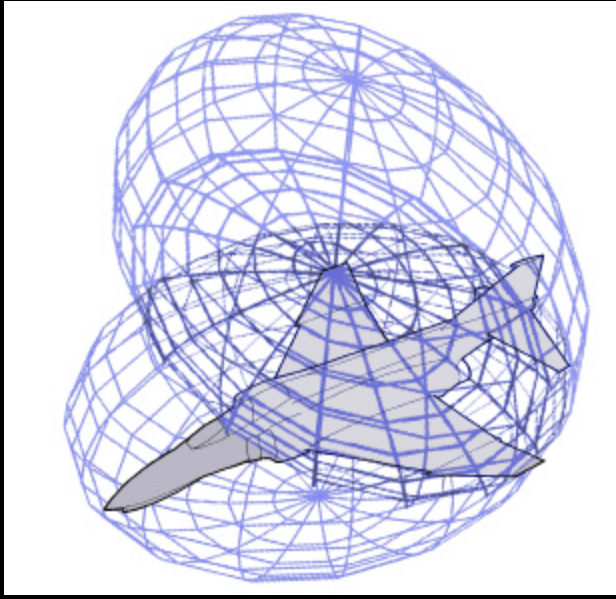
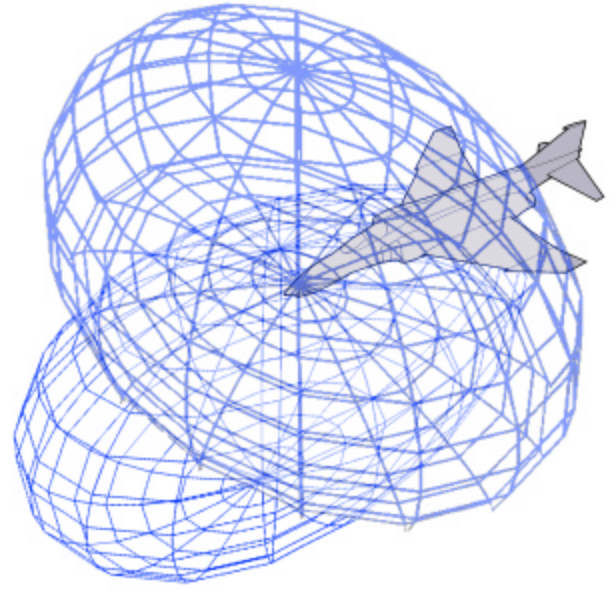


Scoring Systems



WMRA

Program Manager: 2Lt Joseph Pugliese
Lead Engineer: Mr. John Goleta





Vector Doppler Scorer (VDOPS)



WMRA

Description: - Commercial Off-the-Shelf (COTS) system for non-cooperative missile scoring requirements
- Supports air-to-air missile testing (DT & OT) and training programs

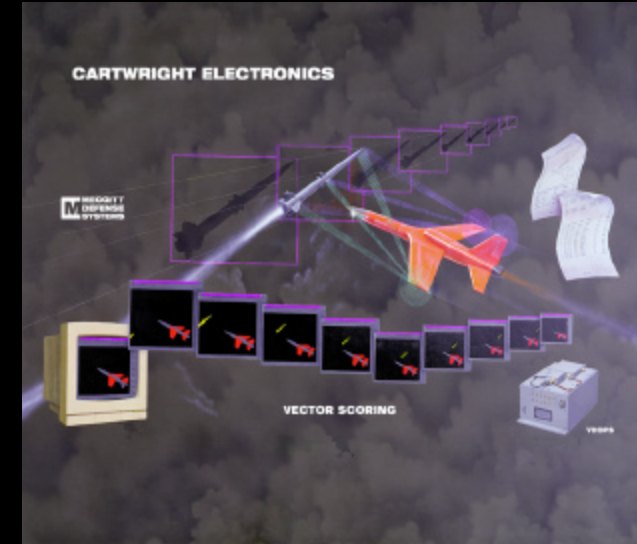
Prime Contractor: Cartwright Electronics

Contract Type(s): Firm-fixed price (Hardware, Spares, Logistics Support, Sustaining Engineering)

Phase: Production / Sustainment (full contractor logistics support)

Initiatives: “Shrink” VDOPS for AFSAT; QF-4 antenna re-design

Issues: - Radio frequency spectrum encroachment





Key Performance Parameters



WMRA

<u>KPPs</u>	<u>Threshold Baseline</u>	<u>Actual Estimate</u>	<u>Variance</u>
Max Position Error	2.0 ft	<2.0 ft	Meets ORD
Max Velocity Error	5%	<1%	Exceeds ORD
Max Attitude Error	5 deg.	<5 deg.	Meets ORD
Timing Correlation	$\pm .1$ ms	$\pm .02$ ms	Exceeds ORD



VDOPS

System Issues



WMRA

- **VDOPS antenna pattern coverage**
 - QF-4 pattern coverage concern for modeling/simulation of missile performance
 - No concern with subscale targets
- **Telemetry RF encroachment**
 - Current VDOPS TM bandwidth sold
 - New user starting ops (2310-2350 MHz)
 - Temporarily able to work “around” new user; need new RF band
 - Options limited, potentially costly
 - L-band: No E-9 TM relay capabilities
 - Lower S-band: Crowded; Hardware mod required



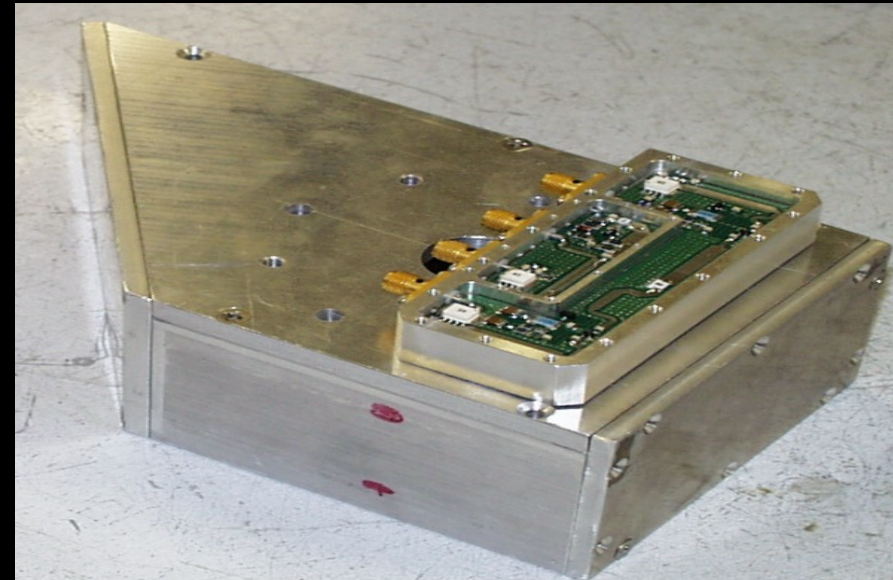
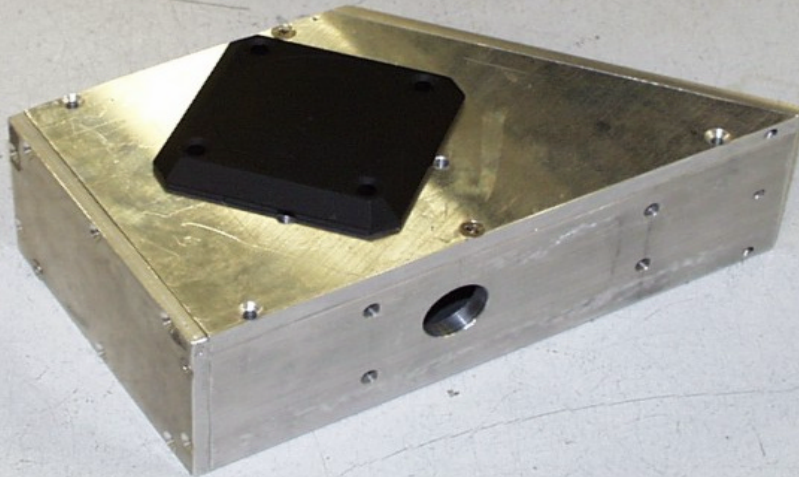
VDOPS

Enhanced Antenna Array



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- **Prototype QF-4 antenna array**
 - Designed to mitigate current full-scale scoring reliability issues
 - **In-line Transmit-Receive Interface Module (TRIM)**
 - Boosts signal / filters “noise”
 - Redesigned antennas to maximize coverage

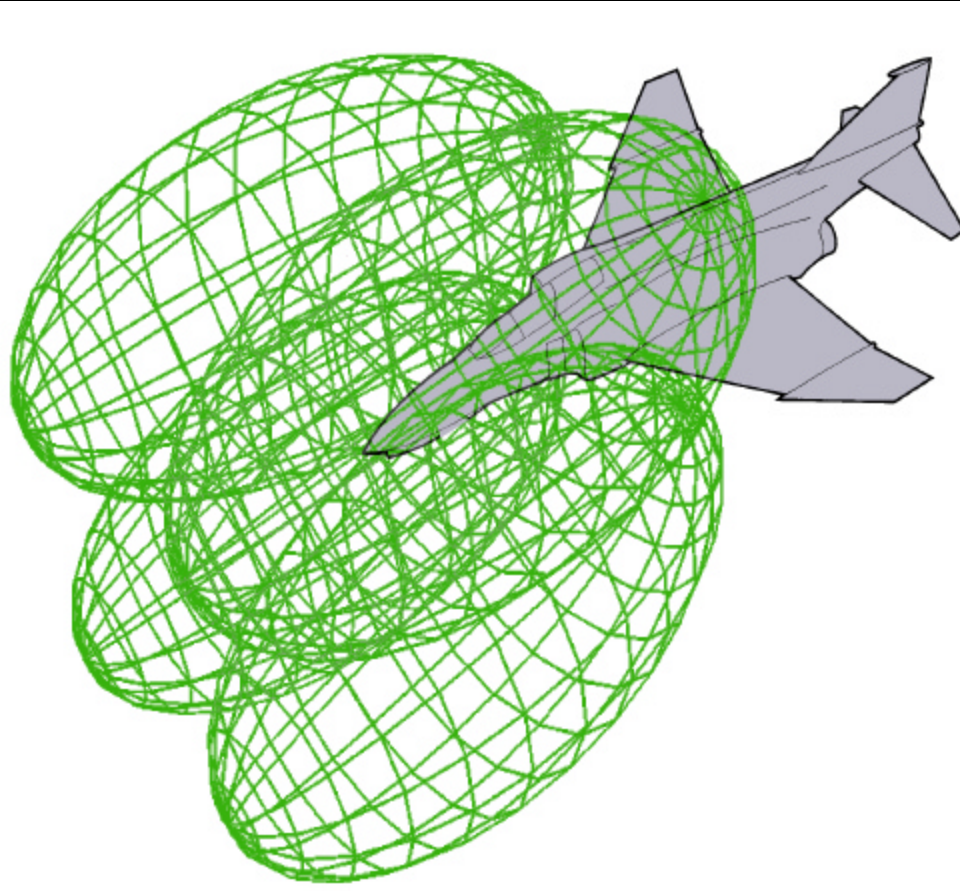




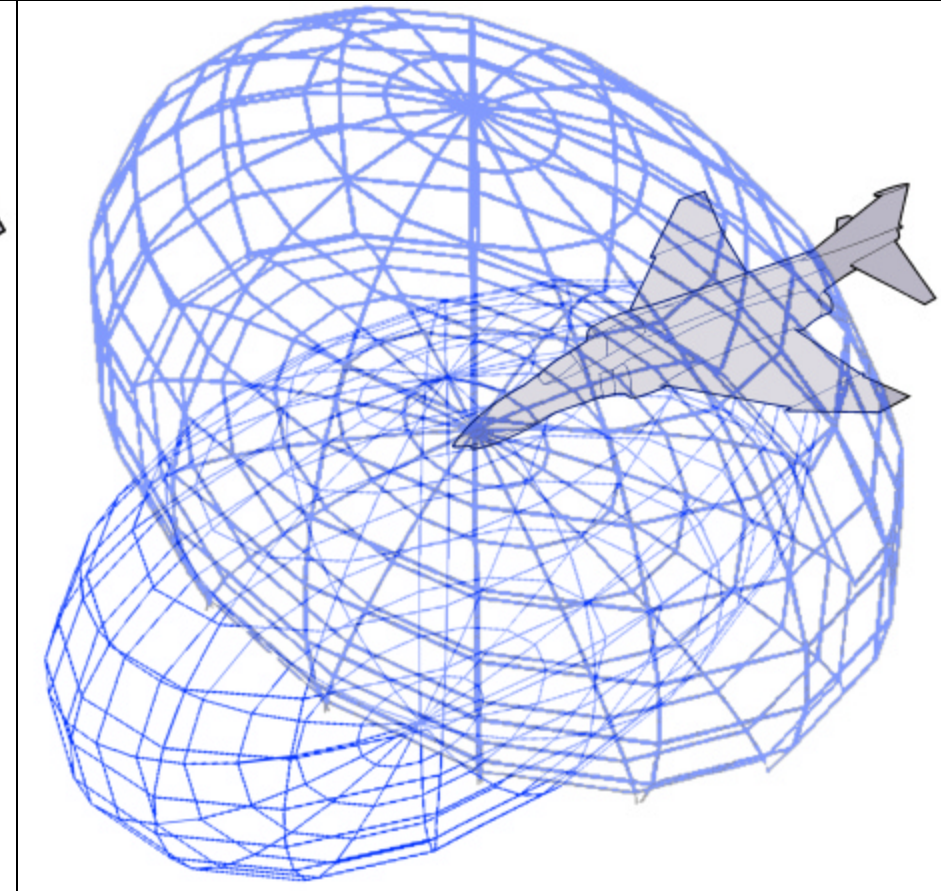
VDOPS Enhanced Antenna Array



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Current Nose Antenna Pattern



Redesigned Nose Antenna Pattern

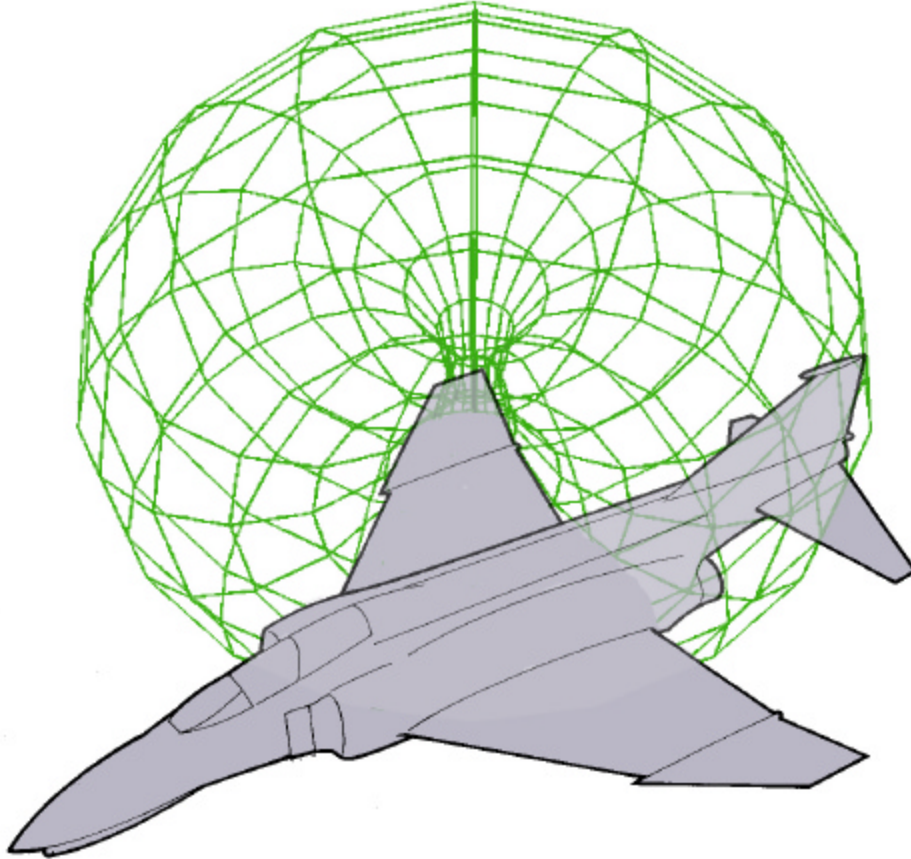
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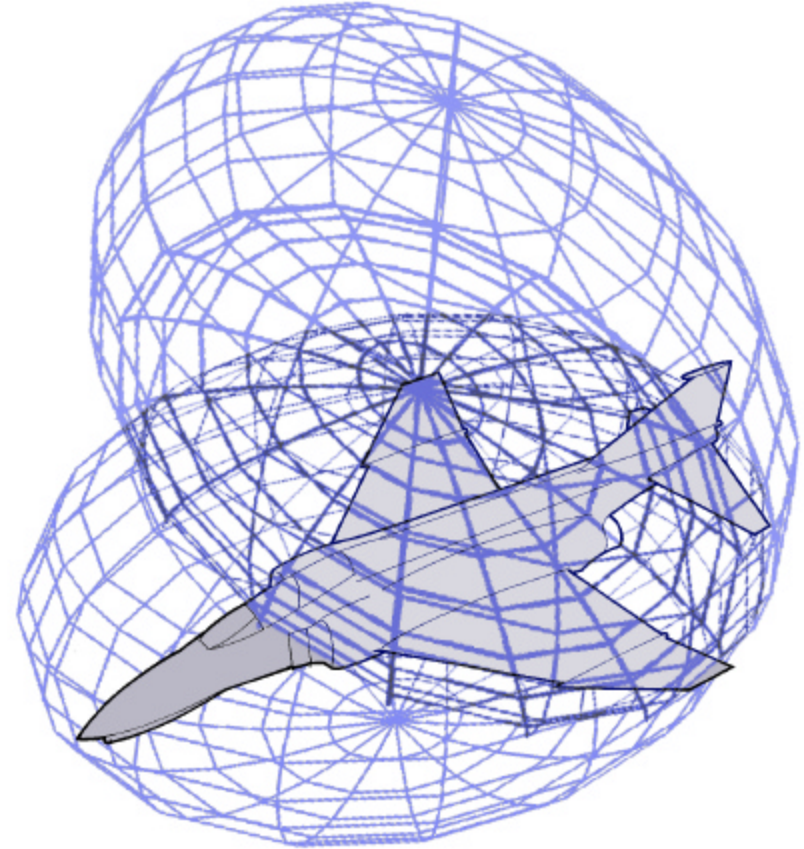
VDOPS Enhanced Antenna Array



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Current Wing Antenna Pattern



Redesigned Wing Antenna Pattern

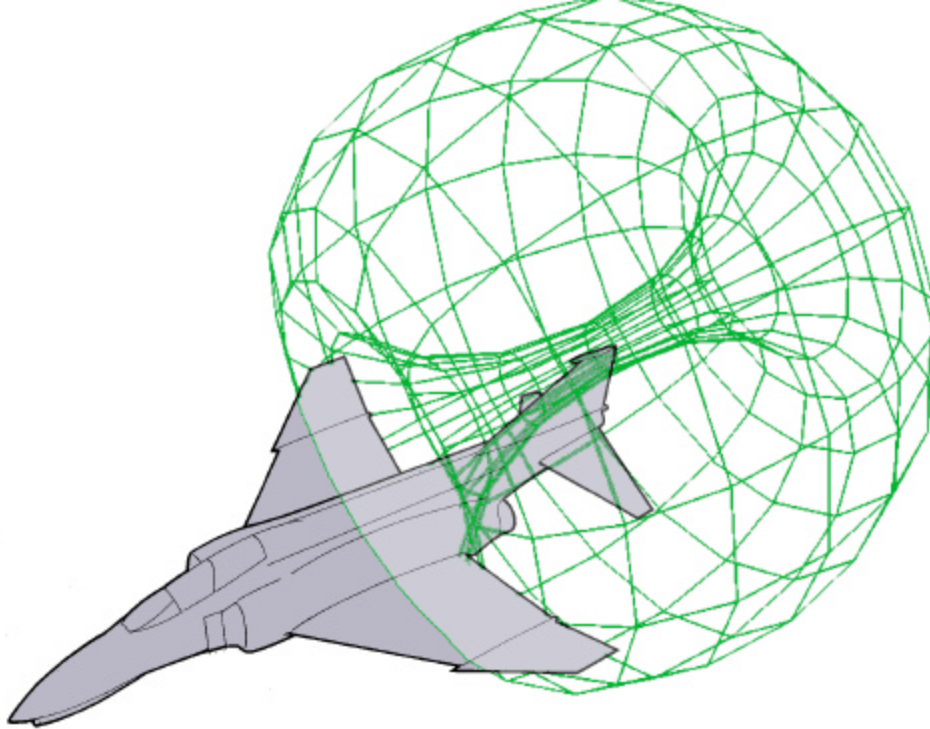
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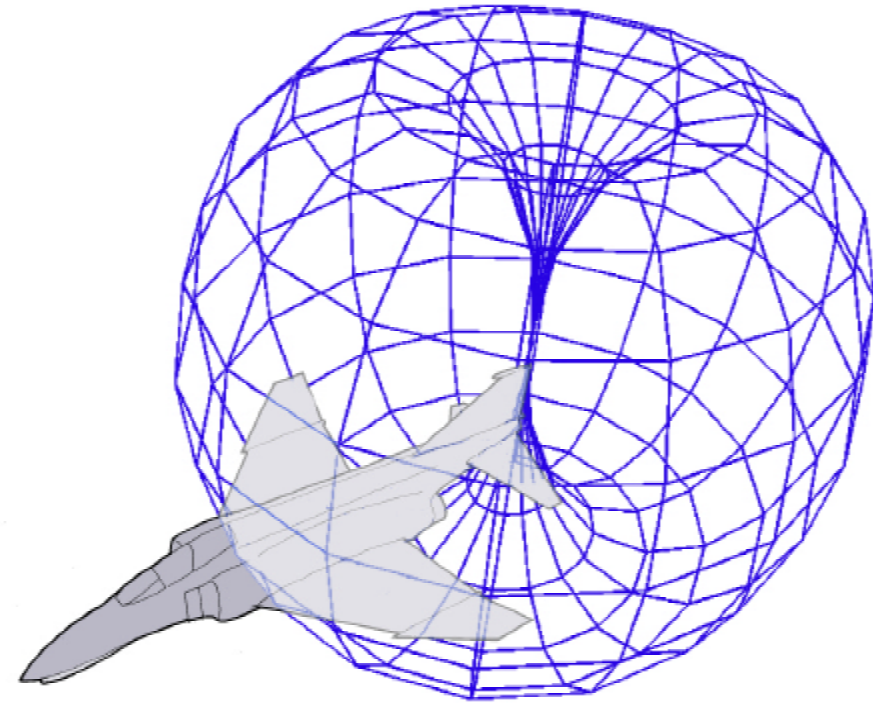
VDOPS Enhanced Antenna Array



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Current Tail Antenna Pattern



Redesigned Tail Antenna Pattern

Not to scale

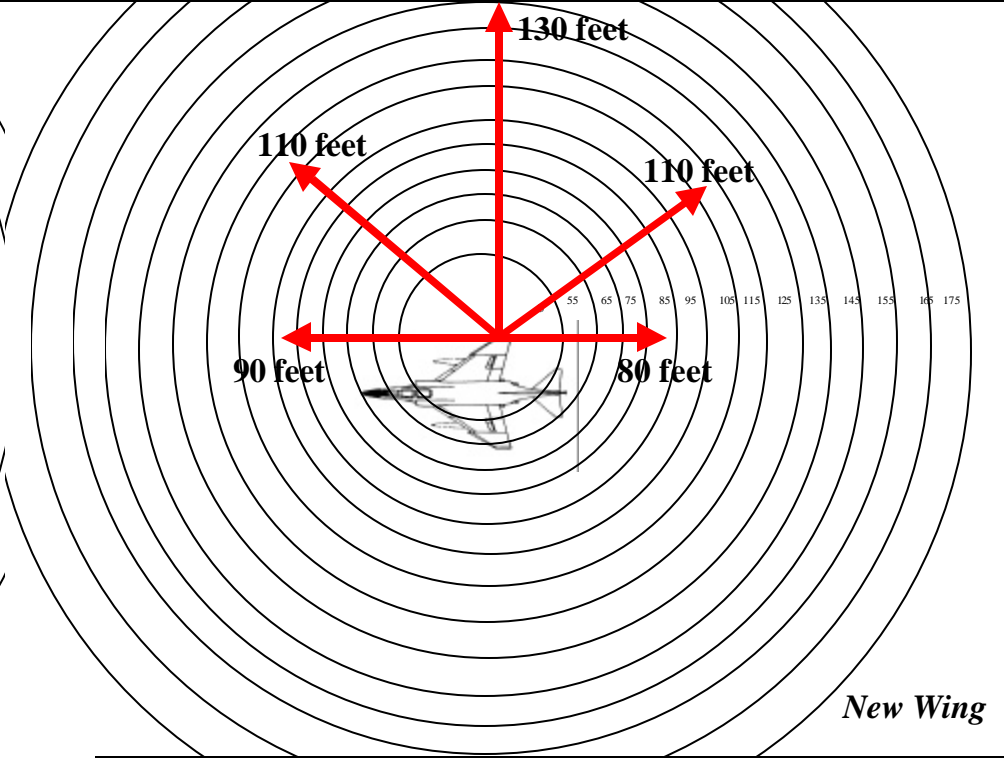
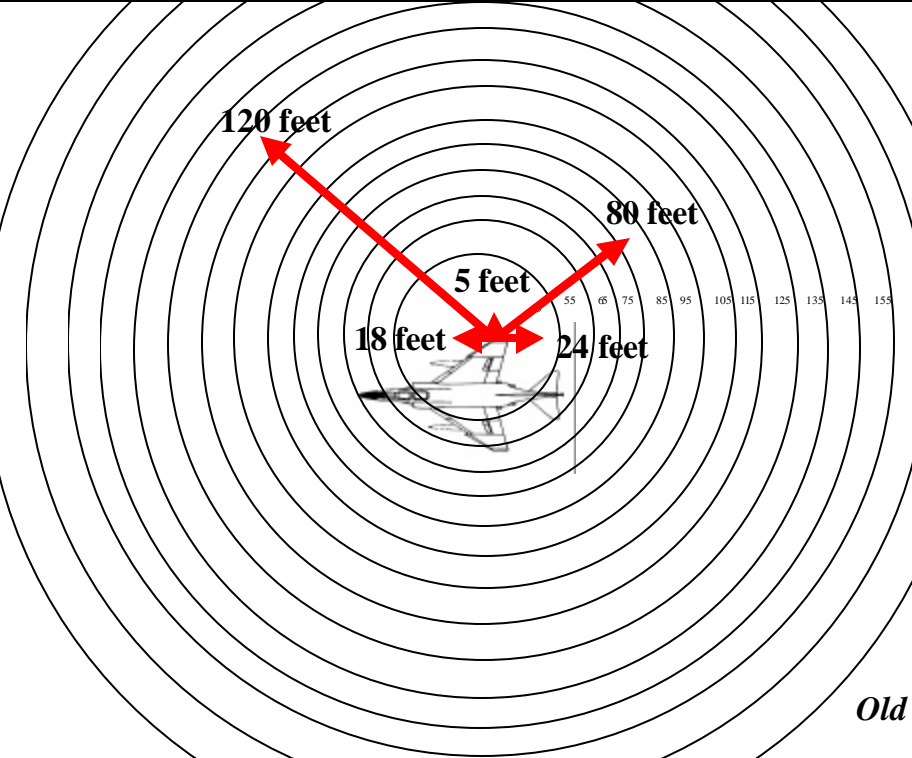


VDOPS

Enhanced Antenna Array



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Current Wing Antenna Readings

Redesigned Wing Antenna Readings

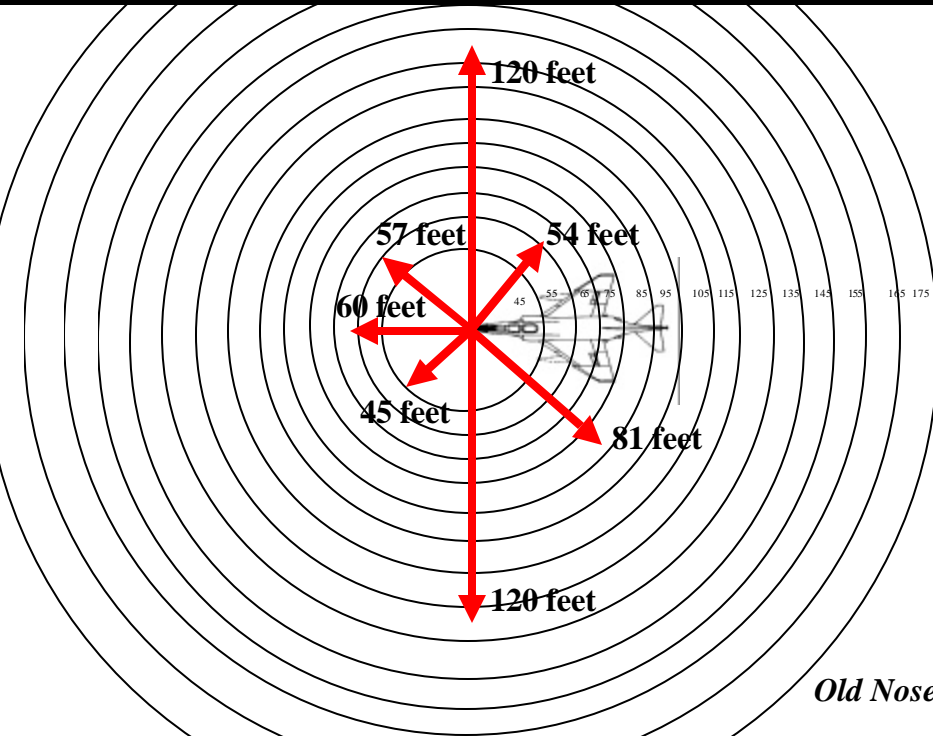


VDOPS

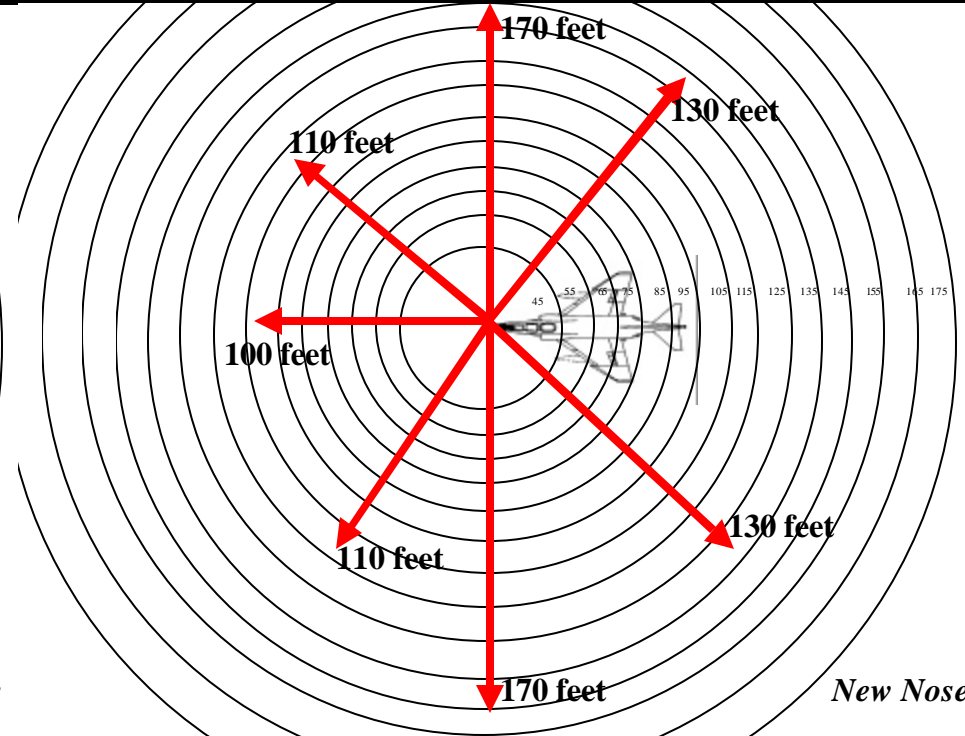
Enhanced Antenna Array



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Current Nose Antenna Readings



Redesigned Nose Antenna Readings



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Future Challenges



WMRA

- **The Days of a “Vanilla” Target are Gone**
 - **Advanced aircraft and cruise missile threats**
 - **Performance**
 - **Signature**
 - **Electronic Attack Countermeasures**
 - **Chaff & Flares**



Common Service Pod TMI

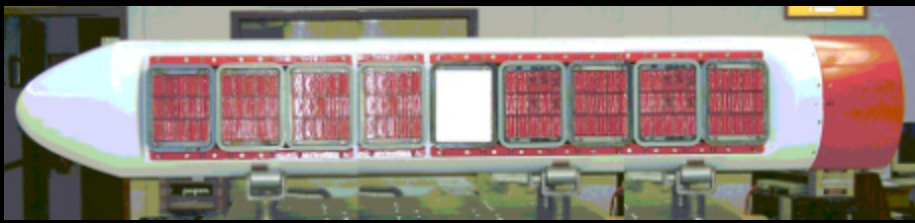


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Mongoose



Common Service Pod (AF version)



“Key” Performance Parameters

- Enable aerial targets to simulate evasion techniques employed by threat fighter aircraft
- Ability to dispense USAF & USN & foreign CM at threat representative rates & numbers from a common design
- Provide this realistic threat capability to a full scale drone
- Integrate existing ALE-47 dispenser system into a stretched Mongoose pod

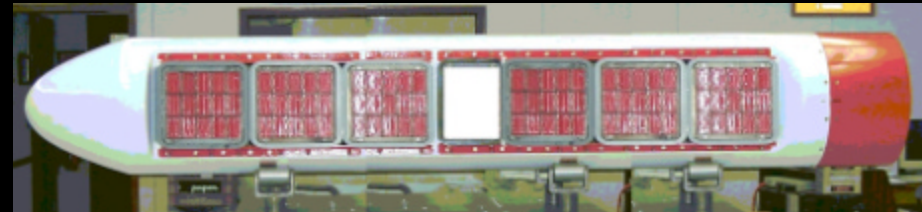
Description

- Design Target Control System (TCS) interface card
- Generate required TCS software changes
- Generate engineering and production drawings
 - Must be suitable for competitive procurements
- Construct prototype
- Ground test
 - Obtain appropriate flight test approvals (SEEK EAGLE, Safety, etc.)
- Flight test
- Document test results vs. requirements

FY 03 Scheduled Effort

- Requirements Review
- Basic Concept Design
- Structural & Aero Analysis
- Basic Electrical Design
- Preliminary Design Review

Common Service Pod (Navy Version)





Subscale IR / IRCM TMI's



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"Key" Performance Parameters

- Better enable subscale targets to emulate enemy threat fighter aircraft in the IR spectrum, far-field

Description

- IR Enhancement TMI will allow use of cheaper subscale for potential full-scale missions
 - Spatially / spectrally similar IR target signature
- IR Countermeasures TMI will replicate threat representative IRCM, including
 - Spectral Intensity
 - Dispense rates
 - Dispense angles

FY03 Scheduled Effort

- Develop/fabricate prototype hardware
- Perform static tests
 - Determine functionality of the prototypes
- Additional effort scheduled in FY04



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An illustration of three knights on donkeys. The knight on the left is on a brown horse, holding a long spear. The knight in the center is on a white donkey, holding a sword. The knight on the right is on a white donkey, holding a sword. All knights are wearing armor and carrying shields with a star and stripes design. The donkeys have "AAC" written on their heads.

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