

# ARCHIVED REPORT

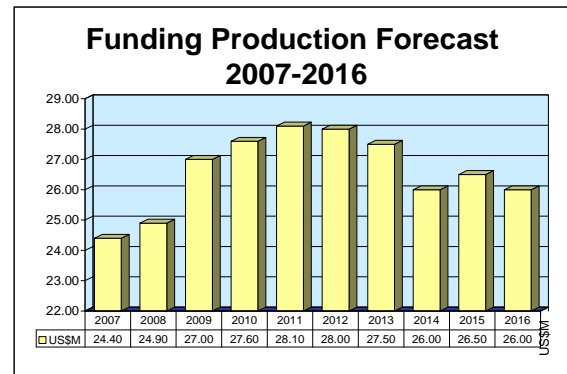
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## EW Technology (Air Force) - Archived 02/2008

### Outlook

- U.S. Air Force's Electronic Combat Technology program is an important part of the United States' ability to disrupt enemy electronic operations along with protecting its own electronic systems on the battlefield
- Expect the USAF to spend \$266 million over the next 10 years
- This report will be archived in 2008; in the future, Forecast International will report on the three individual sub-projects that make up this program, rather than the program as a whole



### Orientation

**Description.** This program, PE#0603270F, funds the development of an advanced technology base in support of electronic warfare programs. Its title is Electronic Combat Technology.

#### Sponsor

United States Air Force  
AF Systems Command  
Aeronautical Systems Center  
ASC/PAM  
Wright-Patterson AFB, OH 45433-6503  
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Electronic Systems Center  
ESC/PAM  
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Hanscom AFB, MA 01731-5000  
USA  
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Web site: <http://www.hanscom.af.mil>

**Status.** Technology-based development.

**Application.** The program will provide a broad technology base that will support electronic warfare equipment development.

### Contractors

Contractor(s) not selected. Contractors may vary as projects change.

### Technical Data

Program Element # 0603270F, Electronic Combat (EC) Technology, funds the development and demonstration of technologies that support Air Force electronic combat

(EC) requirements. The program focuses on developing components, subsystems, and technologies that can be

applied to air combat, special operations, and airlift applications in three project areas.

The first project develops and demonstrates techniques and technologies for integrating EC sensors and systems into a fused and seamless whole.

The second project develops and demonstrates advanced technologies for radio frequency EC suites.

The third project develops and demonstrates advanced warning and countermeasure technologies that can be applied to defeat electro-optical, infrared, and laser threats to aerospace platforms.

This program develops and demonstrates technologies for system upgrades and/or new sensor and EC systems that have military utility and address warfighter needs.

## Program Review

### ***Supports USAF Electronic Combat Capability***

The Electronic Combat Technology program supports the U.S. Air Force's ability to disrupt enemy electronics, as well as protect friendly electronic systems on the battlefield. The program develops and tests new technologies for the U.S. Air Force and has also received funding for international programs, particularly with the United Kingdom. The program is broken into three projects, as described below.

**Project 2432 – Defensive System Fusion Technology.** This project develops and demonstrates technologies to integrate EC sensors and improve EC system fusion. It develops advanced algorithms and assessment techniques that can be used to evaluate combat aircraft operations in multi-spectral threat and countermeasure environments. It also matures technologies required for command and control (C<sup>2</sup>) warfare, standoff jamming, and supports countermeasures for denial, disruption, and suppression of adversary air defense operations.

Integrated technologies include advanced components and techniques needed to jam enemy radars, advanced standoff jammer technologies, and electronic collection methods that can be used to inform field commanders of changes in the electronic environment.

One major effort involves the development of offensive counter-information warfare technologies to disrupt and deny hostile command and control nodes and networks.

#### ***Detailed Flight-Test Plan Finalized in FY04***

In FY04, a detailed flight-test plan was finalized. The tests were to be based on the results of exhaustive ground tests. The electronic attack/electronic support (EA/ES) countermeasures system was then flight-tested for its ability to counter adversary communications and navigation systems, and the results were documented in a final report. In other efforts, hardware and software were designed that would enable the EA/ES system to counter the high-speed, wideband data/communications

links utilized by multiple ground-based and airborne platforms. This effort continued into FY05 and FY06.

In FY07, planners hope to develop an integrated, networked approach to disrupting and denying current and future Integrated Air Defense Systems (IADS). This approach will integrate Radar EA and C<sup>2</sup>W into a distributed EA Sensor Management System.

Another major effort will be the development and integration of advanced sensor receiver and processing technologies. The following is a brief timeline of this effort.

In FY04, risk-reduction demonstrations of defensive sensors were presented. Demonstrated specifically was the fusion of multiple information sources for situational awareness in the Integrated Demonstrations and Applications Laboratory (IDAL).

#### ***Risk Reduction to Continue into FY07***

These risk-reduction demonstrations will continue into FY07, with emphasis on technologies that evolve and optimize sensor fusion algorithms for utilization on tactical platforms and that provide real-time threat situational awareness – specifically, advanced digital receiver and processor technologies that provide the warfighter with multispectral warning, identification, and threat response for current and next-generation aerospace platforms.

A third effort involves the development of affordable radio frequency (RF) and electro-optical (EO) emitter warning concepts and techniques. Details follow.

In FY04, the Air Force continued the affordable threat alert and jamming techniques generator technology development efforts to increase the survivability of combat aircraft against advanced, integrated RF, EO, and infrared air defense systems. Plans were to complete system integration, testing, and laboratory demonstrations toward an advanced digital threat warning and response capability.

In FY05, the program demonstrated affordable threat alert and jamming techniques generator technologies,

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including the implementation of techniques to defeat radar-guided missile systems. These advanced jamming techniques would then be incorporated into flight demonstrations of a significantly improved digital threat warning and response capability. Plans also called for the development of advanced processing and encoding methods for complex emitter signals.

In FY06, a demonstration was launched for an advanced threat alert and jamming subsystem for combat aircraft toward the goal of increasing survivability against advanced, integrated RF, EO, and IR air defense systems. Again, advanced jamming techniques would be incorporated into flight demonstrations of a significantly improved digital threat warning and response capability.

FY07 plans call for completing an engineering model demonstration of the advanced jamming subsystem discussed above. In addition, the final flight-testing will be conducted.

**Project 431G – Radio Frequency Warning and Countermeasures.** This project develops and demonstrates advanced technologies for radio frequency electronic countermeasures suites to enhance the survivability of air and space vehicles and to provide crew situational awareness. Major areas addressed are technologies for missile/threat warning, radar frequency receivers, EC preprocessors, advanced sorting/preprocessing algorithms, and expert software for applications on EC systems.

### ***Focus on RF Countermeasures***

This project also focuses on the development and demonstration of subsystems and components that will generate onboard/offboard RF countermeasure techniques. These include the development of novel electronic countermeasure (ECM) techniques and advanced ECM technologies, such as antennas, power amplifiers, and pre-amplifiers.

One major subproject is the development of wideband, multimode, multifunction apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance).

In FY04, efforts fully characterized adaptive, wideband, conformal phased arrays that have been structurally integrated into future unmanned aerial vehicle aperture and receiver concepts to assess technology readiness levels. The cost of this effort was put at \$2.04 million.

In FY05, designers developed low-cost, wideband and conformal, multiple polarization arrays using “RF-on-Flex” techniques.

In FY06 and FY07, further self-protection countermeasures effective against fourth-generation surface-to-air missile systems will be developed. At the same time, the Air Force will begin development and conduct laboratory evaluations of advanced countermeasures techniques and technology that could be used to defeat an advanced integrated air defense system. In addition, laboratory and field-testing of innovative, networked RF countermeasure techniques against advanced target engagement radars will continue, and anti-jam techniques and technologies for incorporation into advanced RF sensor systems will be developed. Finally, the Air Force will demonstrate a lightweight, low-profile, multifunction, active electronically scanned array on an airborne testbed.

In other plans for FY07, the Air Force will demonstrate the electronic support cross-cueing capabilities of a multi-intelligence sensor suite, including the effects of electromagnetic interference.

Another subproject involves the development and demonstration of aerospace platform self-protection and support jamming technologies and techniques to counter the advanced RF threats associated with aerospace weapon systems. This effort was begun in FY03.

In FY03, the Air Force began developing next-generation monopulse countermeasure systems, and performed laboratory and field tests of advanced electronic protection techniques and technology to protect aerospace radar systems. These efforts continued into FY05.

Plans for FY05 through FY07 were to develop self-protection countermeasures effective against fourth-generation surface-to-air missiles and to conduct laboratory evaluations of countermeasures to defeat an advanced integrated air defense system.

Other efforts in FY06 included demonstrating a lightweight, low-profile, multifunction, active electronically scanned array (AESA) on an airborne testbed and analyzing data compiled from flight-testing so as to predict system performance using advanced computational techniques.

In FY07, the Air Force will demonstrate the electronic support cross-cueing capabilities of a multi-intelligence sensor suite, including the effects of electromagnetic interference.

### ***Congressional Adds in FY04 and FY05***

With respect to Project 431G, there was a congressional add of \$3.4 million in FY04 and \$5.6 million in FY05 for a Lightweight Modular Support Jammer. In FY04, the plan was to design, fabricate, and test technologies

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to support an end-to-end support jammer system with software-reconfigurable digital receivers and processors, countermeasures techniques, a waveform generator, jammer controller, and integrated RF transmitters and arrayed antenna apertures.

In FY05, Congress called for the development and demonstration of a special capability high-band antenna array aperture with wide-bandwidth solid-state power amplifiers. Engineers then developed and demonstrated a wide-bandwidth jammer, and implemented needed hardware modifications and upgrades to provide high-band exciter coverage. In other efforts, engineers made the software modifications necessary for the demonstration of the high-band EA jamming subsystem. Finally, an electronic combat battle management study for distributed and networked EA was conducted.

Another congressional add supported the need for a Receiver and Processing Concepts Evaluation Program, adding \$500,000 in FY04 and \$1.0 million in FY05. In FY04 and FY05, the funding expanded research in advanced RF receiver and processing algorithms using state-of-the art concepts and modern technologies.

Project 691X – EO/IR and Countermeasures Technology. Project 691X – EO/IR Countermeasures Technology project develops and demonstrates the advanced warning and countermeasure technologies required to negate electro-optical, infrared, and laser threats to aerospace platforms. Offboard (decoys and expendables) and onboard countermeasure technologies developed for aircraft self-protection will provide robust, affordable solutions for protection against IR missiles with autonomous seekers, multispectral threats, laser-guided weapons, and EO and IR tracking systems used to direct EO, IR, and RF missiles.

### ***Space Commission Recommends Consolidating Space-unique Tasks***

In FY03, space-unique tasks in this project were transferred to PE#0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate all space-unique tasks. The remaining work included analyzing the vulnerabilities of current IR missile systems and future imaging IR sensors.

During that same fiscal year, the Project 691X engineers conducted analyses of the vulnerabilities of current IR missile systems and future imaging IR sensors. They fabricated an expendable decoy technology suitable for

peacekeeping operations that can be safely deployed at low altitudes over urban areas. Furthermore, the engineers acquired and assessed the capabilities and vulnerabilities of imaging IR sensors used for target acquisition. This work was funded at \$1.822 million. Engineers initiated the design of an airborne laser-warning sensor that can cue agile filter protection for aircrew or sensor protection. This effort was budgeted at \$3.166 million.

In FY04, they continued the analyses and demonstrated/evaluated countermeasure techniques for countering multiple types of imaging IR sensors used for target acquisition. Planners initiated developing low-cost, cooperative techniques to counter imaging IR sensors, which cost \$2.282 million. Engineers also completed the design of an airborne laser-warning sensor that can cue agile filtering for aircrew or sensor protection. They conducted laboratory demonstrations of cueing capabilities. They also tested and demonstrated a multiplatform sensor capable of identifying and classifying battlefield lasers that are dangerous to eyes and sensors. This research was funded at \$4.219 million.

### ***Program Counters Passive Sensors***

In FY05, analyses and evaluation of countermeasure techniques continued. The program also analyzed vulnerabilities of current and future infrared missile systems and developed expendable decoy technology. A capability to locate and counter passive electro-optical and infrared tracking sensors in a laboratory environment was also demonstrated in FY05.

The U.S. Air Force intends to initiate development of advanced laser warning receivers for tactical aircraft in FY06. It will also initiate the development of miniature laser warning equipment for personnel protection and begin testing and evaluating an affordable visible missile warning system (AVMWS) to alert aircrews to the approach of advanced low-signature threats.

### ***Flight Tests Planned for Passive Sensor Detection Capabilities***

Plans for FY07 include conducting digital simulations to assess the effectiveness of decoy techniques, and to conduct flight tests to demonstrate passive EO/IR detection capabilities.

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Funding

		U.S. FUNDING							
		FY05	FY05	FY06	FY06	FY07	FY07	FY08	FY08
		QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
<b>RDT&amp;E (U.S. Air Force)</b>									
PE#0603270F									
Electronic Combat Technology		-	37.89	-	33.34	-	24.44	-	24.86
		FY09	FY09	FY10	FY10	FY11	FY11	FY12	FY12
		QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
<b>RDT&amp;E (U.S. Air Force)</b>									
PE#0603270F									
Electronic Combat Technology		-	26.98	-	27.58	-	28.09	-	TBD

All \$ are in millions.

Source: FY2007 U.S. Budget Documents

Worldwide Distribution/Inventories

This is a **United States Air Force** program that includes some joint development with the **United Kingdom**.

Forecast Rationale

**Important Part of USAF Capability Development**

The U.S. Air Force’s Electronic Combat program is an important part of the United States’ ability to disrupt enemy electronic operations along with protecting its own capabilities. Although funding will decrease slightly after a high in 2011 and 2012, the Air Force is expected to maintain a high level of funding throughout the forecast period.

The program is split into three sub-projects, each of which receives its own funding line. In the future,

Forecast International will report on these individual sub-projects, rather than the program as a whole. FI already has a report about Project 691X – EO/IR Countermeasures Technology. This report will be archived in 2008.

**USAF Could Spend \$266 million**

For the time being, expect the U.S. Air Force to spend \$266 million over the next 10 years. The forecast is based on a continuation of the program element as currently established, and could change as different programs are added or dropped as needed.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR RDT&E FUNDING (in millions US\$)												
Designation or Program	High Confidence					Good Confidence			Speculative			Total
	Thru 2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
MFR Varies												
<b>EW TECHNOLOGY United States Air Force</b>												
	526.41	24.40	24.90	27.00	27.60	28.10	28.00	27.50	26.00	26.50	26.00	266.00
<b>Total</b>	526.41	24.40	24.90	27.00	27.60	28.10	28.00	27.50	26.00	26.50	26.00	266.00