PE NUMBER: 0603270F
PE TITLE: Electronic Combat Technology

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603270F Electronic Combat Technology

	Cost ($ in Millions)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	32.347	39.234	23.923	24.159	24.489	26.562	27.162	27.665	Continuing	TBD
2432	Defensive System Fusion Technology	9.031	7.590	5.540	5.124	5.192	5.632	5.751	5.859	Continuing	TBD
431G	RF Warning & Countermeasures Tech	10.496	14.734	8.030	8.292	8.405	9.116	9.352	9.526	Continuing	TBD
691X	EO/IR Warning & Countermeasures Tech	12.820	16.910	10.353	10.743	10.892	11.814	12.059	12.280	Continuing	TBD

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to support Air Force electronic combat (EC) warfighting capabilities. The program focuses on developing components, subsystems, and technologies with potential aerospace combat, special operations, and airlift EC applications in three project areas. The first project develops and demonstrates 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 to defeat electro-optical, infrared, and laser threats to aerospace platforms. Note: In FY 2005, Congress added $1.0 million for Receiver and Processing Concepts Evaluation Program, $1.4 million for Detect and Avoid for UAVs, $5.6 million for Lightweight Modular Support Jammer, and $3.3 million for Affordable Visible Missile Warning Systems. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and EC system developments that have military utility and address warfighter needs.

(U) B. Program Change Summary ($ in Millions)

		FY 2004	FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	34.597	28.282	26.555	26.318
(U)	Current PBR/President's Budget	32.347	39.234	23.923	24.159
(U)	Total Adjustments	-2.250	10.952		
(U)	Congressional Program Reductions				
	Congressional Rescissions		-0.348		
	Congressional Increases		11.300		
	Reprogrammings	-0.915			
	SBIR/STTR Transfer	-1.335			
(U)	Significant Program Changes:				

Not Applicable.

C. Performance Metrics

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2005
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603270F Electronic Combat Technology**

Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603270F Electronic Combat Technology

PROJECT NUMBER AND TITLE: 2432 Defensive System Fusion Technology

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2432	Defensive System Fusion Technology	9.031	7.590	5.540	5.124	5.192	5.632	5.751	5.859	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates technologies for integrating EC sensors and EC system fusion. It develops advanced algorithms and assessment techniques needed to evaluate and enable combat aircraft operations in multi-spectral threat and countermeasure environments. It also matures technologies required for command and control warfare (C2W), stand off jamming, and electronic support measures for the denial, disruption, and suppression of adversary air defense operations. Technologies included are: advanced components and techniques needed to jam enemy radars; advanced standoff jammer technologies; and electronic collection methods to inform field commanders of changes in the electronic environment.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and investigate offensive counter information warfare technologies to disrupt and deny hostile command and control nodes and networks.	3.823	2.949	1.376	0.031
(U) In FY 2004: Finalized the detailed flight test plan based on the results of exhaustive ground tests. Flight tested the Electronic Attack/Electronic Support (EA/ES) countermeasures system to counter adversary communication and navigation systems. Documented system design and ground/flight test results in a final report. Designed hardware and software for the EA/ES system to counter high-speed, wideband data/communication links utilized by multiple ground-based and airborne platforms. Fabricated hardware to process and attack the threat network.				
(U) In FY 2005: Integrate flyable hardware and software for the EA/ES support system to counter high-speed, wideband data and communication links utilized by multiple ground-based and airborne platforms.				
(U) In FY 2006: Complete the EA/ES support system integration. Conduct laboratory and field tests of the countermeasure system to verify the capability to counter high-speed, wideband data communication links utilized by multiple ground-based and airborne platforms.				
(U) In FY 2007: Develop an integrated, networked approach to disrupt and deny current and future Integrated Air Defense Systems (IADS). This approach will integrate Radar EA and C2W into a distributed EA Sensor Management System.				
(U)				
(U) MAJOR THRUST: Develop and integrate advanced sensor receiver and processing technologies.	2.033	2.027	0.236	0.444
(U) In FY 2004: Conducted evaluations and risk reduction demonstrations of defensive sensors and the fusion of multiple information sources for situational awareness in the Integrated Demonstrations and				

Applications Laboratory (IDAL). Continued conducting IDAL laboratory risk reduction evaluations and demonstrations that evolve and optimize sensor fusion algorithms.

(U) In FY 2005: Conduct further evaluations and risk reduction demonstrations of defensive sensors and fusion of multiple information sources for situational awareness in the IDAL. Continue conducting IDAL laboratory risk reduction evaluations and demonstrations that evolve and optimize sensor fusion algorithms for utilization on tactical platforms that provide real-time threat situational awareness. Conduct IDAL laboratory risk reduction evaluations and demonstrations for advanced digital receiver and processor technologies that provide the warfighter with multispectral warning, identification, and threat response for current and next generation aerospace platforms.

(U) In FY 2006: Perform risk reduction for defensive sensors using multiple information sources for situational awareness in the IDAL. Conduct IDAL laboratory risk reduction evaluations and demonstrations that evolve and optimize network electronic attack techniques on disparate platforms. Conduct IDAL laboratory demonstrations of advanced digital receiver and processor technologies that provide the warfighter with multispectral warning, identification, and threat response for current and next generation aerospace platforms.

(U) In FY 2007: Continue risk reduction for defensive sensors using multiple information sources for situational awareness in the IDAL. Continue IDAL laboratory risk reduction evaluations and demonstrations that evolve and optimize network electronic attack techniques on disparate platforms. Perform demonstrations of advanced multiplatform digital receiver and processor technologies that provide the warfighter with multispectral warning, identification, and threat response for current and next generation aerospace platforms.

(U)

(U) MAJOR THRUST: Develop affordable radio frequency (RF) and electro-optical (EO) emitter warning concepts and techniques.	3.175	2.614	3.928	4.649

(U) In FY 2004: Developed affordable threat alert and jamming techniques generator technologies for combat aircraft to increase survivability against advanced, integrated RF, EO, and infrared (IR) air defense systems, including trade study analyses for techniques to defeat future threat radar guided missile systems. Completed system integration, tests, and laboratory demonstrations for an advanced digital threat warning and response capability.

(U) In FY 2005: Demonstrate affordable threat alert and jamming techniques generator technologies for combat aircraft to increase survivability against advanced, integrated RF, EO, and IR air defense systems, including implementation of techniques to defeat future threat radar guided missile systems. Incorporate advanced jamming techniques into plans for flight demonstrations of a significantly improved digital threat warning and response capability. Develop advanced processing and encoding methods for

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
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complex emitter signals.

(U) In FY 2006: Design and initiate demonstration of advanced threat alert and jamming subsystem for combat aircraft to increase survivability against advanced, integrated RF, EO, and IR air defense systems. Perform initial flight tests to select advanced jamming techniques for a significantly improved digital threat warning and response capability.

(U) In FY 2007: Complete engineering model demonstration of advanced threat alert and jamming subsystem for combat aircraft to increase survivability against advanced, integrated RF, EO, and IR air defense systems. Perform final flight tests to validate advanced jamming techniques for a significantly improved digital threat warning and response capability.

(U) Total Cost	9.031	7.590	5.540	5.124

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602204F, Aerospace Sensors.										
(U) PE 0603203F, Advanced Aerospace Sensors.										
(U) PE 0603500F, Multi-disciplinary Advanced Space Technology.										
(U) PE 0604270F, Electronic Warfare (EW) Development.										
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2005
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603270F Electronic Combat Technology	PROJECT NUMBER AND TITLE: 431G RF Warning & Countermeasures Tech	

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
431G	RF Warning & Countermeasures Tech	10.496	14.734	8.030	8.292	8.405	9.116	9.352	9.526	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced technologies for RF EC suites to enhance the survivability of aerospace vehicles and to provide crew situational awareness. One major area addresses technologies for missile/threat warning, RF receivers, EC preprocessors, advanced sorting/preprocessing algorithms, and expert software for applications on existing and future EC systems. Another major technology area focuses on the development and demonstration of subsystems and components for generating on-board/off-board RF countermeasure techniques. This includes the development of electronic countermeasures (ECM) techniques, as well as advanced ECM technologies such as antennas, power amplifiers, preamplifiers, etc.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop wideband, multi-mode, multi-function apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance).	1.699	3.262	1.386	0.959
(U) In FY 2004: Fully characterized adaptive, wideband, conformal phased arrays that have been structurally integrated into future unmanned aerial vehicle (UAV) aperture and receiver concepts to assess technology readiness levels.				
(U) In FY 2005: Develop low-cost wideband and conformal, multiple polarization arrays through the use of RF-on-Flex techniques.				
(U) In FY 2006: Design and fabricate critical aperture and receiver subsystems for an efficient, low frequency, wide band aperture compatible with UAV platforms.				
(U) In FY 2007: Test critical subsystems of an efficient, low frequency, wide band aperture, and fabricate array compatible with UAV platforms.				
(U)				
(U) MAJOR THRUST: Develop aerospace platform self-protection and support jamming technologies and techniques to counter advanced RF threats associated with current and future aerospace weapon systems.	4.897	4.872	6.644	7.333
(U) In FY 2004: Developed and initiated testing of next generation monopulse countermeasure systems for Air Force aerospace platforms. Performed laboratory testing of innovative RF countermeasure techniques for aerospace platforms against future RF threat systems. Developed innovative electronic protection techniques in advanced radar systems. Laboratory and field tested these techniques.				
(U) In FY 2005: Develop self-protection countermeasures effective against fourth generation surface-to-air missile systems. Conduct laboratory evaluations of countermeasures to defeat an advanced integrated air				

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
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	defense system. Laboratory and field-test innovative, networked RF countermeasure techniques against advanced target engagement radars. Develop anti-jam technologies for advanced RF sensor systems.				
(U)	In FY 2006: Further develop self-protection countermeasures effective against fourth generation surface-to-air missile systems. Begin development and conduct laboratory evaluations of advanced countermeasures techniques and technology to defeat an advanced integrated air defense system. Continue laboratory and field-testing of innovative, networked RF countermeasure techniques against advanced target engagement radars. Further develop anti-jam techniques and technologies for advanced RF sensor systems. Demonstrate a lightweight, low-profile, multi-function, active electronically scanned array on an airborne test bed. Analyze data from flight test and predict system performance using advanced computational techniques.				
(U)	In FY 2007: Continue developing self-protection countermeasures effective against advanced future surface-to-air missile systems. Conduct further laboratory and field-testing of innovative, networked RF countermeasure techniques against advanced target engagement radars. Continue development of advanced countermeasures techniques and technology to defeat an advanced integrated air defense system. Continue developing anti-jam techniques and technologies for advanced RF sensor systems. Demonstrate electronic support cross-cueing capabilities of a multi-intelligence sensor suite including the effects of electromagnetic interference and platform compatibility to provide precision location and identification with increased probability of intercept.				
(U)					
(U)	CONGRESSIONAL ADD: Lightweight Modular Support Jammer.	3.400	5.600	0.000	0.000
(U)	In FY 2004: Designed, fabricated, and tested technologies 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.				
(U)	In FY 2005: Develop and demonstrate a special capability high band antenna array aperture with wide bandwidth solid state power amplifiers. Develop and demonstrate a wide bandwidth jamming techniques generator. Implement needed hardware modifications and upgrades to the system to provide high band exciter coverage. Implement software modifications to the software system needed for demonstration of the high band EA jamming subsystem. Perform an electronic combat battle management study for distributed and networked EA.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Receiver and Processing Concepts Evaluation Program.	0.500	1.000	0.000	0.000
(U)	In FY 2004: Expanded research in advanced RF receiver and processing algorithms using state-of-the art				

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology	PROJECT NUMBER AND TITLE 431G RF Warning & Countermeasures Tech

concepts and modern technologies.

(U) In FY 2005: Further expand research in advanced RF receiver and processing algorithms using state-of-the art concepts and modern technologies.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Not Applicable.

(U) Total Cost	10.496	14.734	8.030	8.292

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602204F, Aerospace Sensors.

(U) PE 0604270F, Electronic Warfare (EW) Development.

(U) PE 0603500F, Multi-disciplinary Advanced Space Technology.

(U) PE 0604270N, EW Development.

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603270F Electronic Combat Technology

PROJECT NUMBER AND TITLE: 691X EO/IR Warning & Countermeasures Tech

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
691X	EO/IR Warning & Countermeasures Tech	12.820	16.910	10.353	10.743	10.892	11.814	12.059	12.280	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates the advanced warning and countermeasure technologies required to negate electro-optical (EO), infrared (IR), and laser threats to aerospace platforms. Off-board (decoys and expendables) and on-board countermeasure technologies developed for aircraft self-protection will provide robust, affordable solutions for protection against IR missiles with autonomous seekers, multi-spectral threats, laser-guided weapons, and EO and IR tracking systems used to direct EO, IR, and radar-guided missiles.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Analyze the vulnerabilities of current IR missile systems and future imaging IR sensors. Note: Increased funding in FY 2006 supports field demonstration of cooperative techniques and expendable decoys with modified spatial and kinematic properties for countering IR missiles.	1.925	2.357	4.464	1.262
(U) In FY 2004: Conducted in-house analyses on vulnerabilities of current and future IR imaging sensors and missiles. Demonstrated and evaluated countermeasure techniques for countering multiple types of imaging IR sensors used for target acquisition. Developed low-cost, cooperative techniques to counter imaging IR sensors.				
(U) In FY 2005: Continue in-house analyses on current IR-guided missile susceptibilities and future imaging IR sensors. Further evaluation of countermeasure (CM) techniques for countering multiple types of imaging IR sensors used for target acquisition. Initiate developing low-cost, cooperative techniques to counter imaging IR sensors. Continue designing and begin developing expendable decoy technology with modified spatial and kinematic properties that can be used to deceive imaging IR missiles.				
(U) In FY 2006: Further conduct in-house analyses on IR-guided missile and future imaging IR sensor susceptibilities. Continue evaluating CM techniques for countering multiple types of missiles and imaging IR sensors.				
(U) In FY 2007: Continue conducting in-house analyses on IR guided missiles and future imaging IR sensor susceptibilities. Further evaluation of CM techniques for countering multiple types of missiles and imaging IR sensors. Conduct digital simulations to assess the effectiveness of spatial decoy techniques against imaging IR missiles under flyout conditions. Assess proposed advanced CM techniques to defeat imaging IR sensors.				
(U)				
(U) MAJOR THRUST: Develop aerospace laser warning sensor technologies for timely alert to advanced	3.559	3.987	1.236	1.324

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	laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser-guided ordnance) signals.				
(U)	In FY 2004: Completed design of an airborne laser warning sensor that can cue agile filter protection for aircrew or sensor protection. Conducted laboratory demonstration of cueing capabilities. Tested and demonstrated a multi-platform sensor capable of identifying and classifying battlefield lasers that are dangerous to eyes and sensors.				
(U)	In FY 2005: Initiate risk reduction research and development for continuous wave and femto-second lasers from remote vehicles and sensors. Initiate development of advanced eye and sensor protection cueing concepts tailored for specific operational deficiencies. Initiate laser warning sensor package for integration into UAVs and NVGs.				
(U)	In FY 2006: Initiate development of advanced laser warning receivers for aircraft. Continue developing a laser warning sensor technologies to address emerging laser threats. Continue laser warning sensor packages for integration into UAVs and NVGs.				
(U)	In FY 2007: Initiate development of an advanced laser warning receiver for integration into tactical aircraft. Continue developing laser warning sensor technologies to address emerging laser threats. Initiate miniature laser warning for personnel protection.				
(U)					
(U)	MAJOR THRUST: Develop a countermeasure technology to defeat passive EO and IR aircraft tracking sensors and ordnance guidance.	3.899	4.652	3.703	7.256
(U)	In FY 2004: Completed designing a sensor system that can locate and counter passive threats beyond kinematic launch boundaries. Completed assessment of multiple threats and threat surrogates. Developed a laboratory testbed.				
(U)	In FY 2005: Demonstrate laboratory capability to locate and counter passive threats before threats can develop a fire control solution. Initiate fabricating a testbed for field demonstrations over extended ranges.				
(U)	In FY 2006: Complete development of testbed to locate and counter passive threats before threats can develop a fire control solution. Conduct field demonstration over extended ranges to demonstrate capability. Initiate testbed integration on aircraft for flight demonstrations over full required range.				
(U)	In FY 2007: Complete integration of testbed on aircraft. Conduct flight test demonstration of the capability to locate and counter passive threats over required range before threats can develop a fire control solution.				
(U)					
(U)	MAJOR THRUST: Develop EO/IR missile warning technologies to alert aircrews and aircraft self-protection systems to the approach of advanced, low-signature threats.	0.937	1.214	0.950	0.901

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
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(U) In FY 2004: Established spatial, spectral, and temporal trade space for advanced missile warning sensors optimized for detecting low contrast missile threats in high clutter backgrounds. Performed airborne experiments to quantify expected performance.
(U) In FY 2005: Perform a concept evaluation of a visible band passive warning sensor that can provide timely countermeasure initiation with high declaration probability and low false alarm rate.
(U) In FY 2006: Perform integration of subsystem components into affordable visible missile warning system (AVMWS). Perform test and evaluation of AVMWS. Coordinate AVMWS development with the Affordable Laser Infrared Survivability System countermeasure system.
(U) In FY 2007: Complete test and evaluation of AVMWS.
(U)

(U) CONGRESSIONAL ADD: Detect and Avoid for UAV. Note: In FY 2003, this Add was titled Test Detect and Avoid Technology for Federal Aviation Administration (FAA).	2.500	1.400	0.000	0.000

(U) In FY 2004: Implemented an interim see and avoid system UAVs that meets with FAA approval to do limited flying in national airspace without a chase aircraft.
(U) In FY 2005: Integrate and demonstrate see and avoid wide field of regard sensor subsystem, high performance field programmable gate array processors, and detection algorithms.
(U) In FY 2006: Not Applicable.
(U) In FY 2007: Not Applicable.
(U)

(U) CONGRESSIONAL ADD: Affordable Missile Warning Systems	0.000	3.300	0.000	0.000

(U) In FY 2004: Not Applicable.
(U) In FY 2005: Initiate fabrication of passive, visible band missile warning subsystems to provide a system to provide timely countermeasure initiation with high declaration probability and low false alarm rate. Subsystems to be fabricated include the sensor, data processor, and detection algorithms.
(U) In FY 2006: Not Applicable.
(U) In FY 2007: Not Applicable.

(U) Total Cost	12.820	16.910	10.353	10.743

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602204F, Aerospace Sensors.										

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(U) C. Other Program Funding Summary ($ in Millions)

(U) PE 0604270F, Electronic Warfare (EW) Development.

(U) PE 0603500F, Multi-disciplinary Advanced Development Space Technology.

(U) PE 0604270N, EW Development.

(U) PE 0603203F, Advanced Aerospace Sensors.

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.