Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Air Force											Date: February 2015	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603270F / *Electronic Combat Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**Cost To Complete**	**Total Cost**
Total Program Element	-	42.516	47.508	47.032	-	47.032	54.250	55.851	56.580	57.704	Continuing	Continuing
633720: *EW Quick Reaction Capabilities*	-	17.194	28.668	27.171	-	27.171	33.547	35.641	36.486	37.212	Continuing	Continuing
63431G: *RF Warning & Countermeasures Tech*	-	20.692	14.484	15.800	-	15.800	15.671	15.284	15.237	15.539	Continuing	Continuing
63691X: *EO/IR Warning & Countermeasures Tech*	-	4.630	4.356	4.061	-	4.061	5.032	4.926	4.857	4.953	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to support Air Force electronic combat warfighting capabilities. The program focuses on developing components, subsystems, and technologies with potential aerospace combat, special operations, and airlift electronic combat applications in four project areas. The first project develops and demonstrates technologies for integrating electronic combat sensors and systems into a fused and seamless whole. The second project integrates and focuses research efforts in electronic warfare (EW), directed energy weapons (DEW), and cyber warfare to rapidly demonstrate a capability for rapid fielding. The third project develops and demonstrates advanced technologies for radio-frequency electronic combat suites. The fourth project develops and demonstrates advanced warning and countermeasure technologies to defeat electro-optical, infrared, and laser threats to aerospace platforms. This program has been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

B. Program Change Summary ($ in Millions)	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total
Previous President's Budget	43.381	47.602	49.502	-	49.502
Current President's Budget	42.516	47.508	47.032	-	47.032
Total Adjustments	-0.865	-0.094	-2.470	-	-2.470
• Congressional General Reductions	-	-0.094			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.865	-			
• Other Adjustments	-	-	-2.470	-	-2.470

Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Air Force	Date: February 2015
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603270F / *Electronic Combat Technology*

Change Summary Explanation

Decrease in FY16 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2016 Air Force			Date: February 2015
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / *Electronic Combat Technology*	Project (Number/Name) 633720 / *EW Quick Reaction Capabilities*	

COST ($ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
633720: *EW Quick Reaction Capabilities*	-	17.194	28.668	27.171	-	27.171	33.547	35.641	36.486	37.212	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project establishes a capability to rapidly assess, develop and demonstrate new electronic warfare concepts, techniques, and capabilities in the context of systemic electronic warfare (EW) effects (EW-threat interactions) in a congested/contested electromagnetic spectrum (EMS), system-of-systems (SoS) environment of the future. It develops disruptive EW and countermeasures concepts specifically selected for high-impact, game-changing effects; evaluates them in high fidelity virtual and hardware evaluation settings; and demonstrates them in an operationally relevant environment. It establishes and maintains an all-source, physics-based, threat-to-countermeasures EW systems engineering methodology. It develops a core analytic function, supported by simulation-based wargaming and interactive engineering modeling capabilities to evaluate advanced countermeasures concepts.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: Disruptive Electronic Warfare (EW) and Countermeasure Technologies	3.794	13.493	12.121
Description: Develop disruptive EW and countermeasure concepts specifically selected for rapidly fieldable, high-impact effects and demonstrate them in an operational environment. ***FY 2014 Accomplishments:*** Developed disruptive EW and countermeasures concepts and technologies specifically selected for high impact effects and demonstrated them in simulated or operational environments. Expanded these SoS developments to include GPS-denied techniques and technology solutions, networked-systems electronic protection (EP), and effects experimentation between/across EMS, cyber and directed energy (DE) domains. ***FY 2015 Plans:*** Focus research on investigating the use of directed energy and cyber effects for EW use against Radio Frequency (RF) threats. Determine trade space and conduct experiments of these disruptive technologies against integrated air defense systems and other RF threats. Explore multi-spectral approaches to defense against these threat systems. ***FY 2016 Plans:*** Leverage developments in directed energy and cyber techniques to effectively simulate electronic attack against a modeled integrated air defense network to determine deficiencies in the attack capability. Focus research methods to mitigate the determined deficiencies in attack methodology and develop alternative strategies for employment to enable successful suppression of integrated air defense systems.			
Title: Threat-to-Countermeasure System of Systems (SoS) Methods	5.800	7.020	7.032

Exhibit R-2A, RDT&E Project Justification: PB 2016 Air Force		Date: February 2015
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603270F / *Electronic Combat Technology*	**Project (Number/Name)** 633720 / *EW Quick Reaction Capabilities*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Description: Establish and maintain an all-source, physics-based, design-level, red-blue, comparative, threat-to-countermeasure SoS techniques methodology. This systems engineering-based electronic warfare (EW) approach will inform programmatic planning, quantify desirable research areas with realistic SoS metrics, and foster improved understanding of future concept contributions to EW warfighting capabilities. ***FY 2014 Accomplishments:*** Developed an all source, physics based, design level, red-blue, comparative, threat-to countermeasure SoS techniques methodology for use in concept development and simulation based testing. Initiated integration of SoS engineering methods across virtual/modeling, hardware-in-the-loop (HWIL) and systems integration lab (SIL) options to optimize end-to-end (threat-to-countermeasure) systemic effects. ***FY 2015 Plans:*** Improve in-house system of systems analysis capabilities in order to develop new techniques to address multi-spectral EW threats. Conduct initial systems engineering research on new technology initiatives in order to provide physics based, metric-driven projects that will address threats to countermeasure systems. ***FY 2016 Plans:*** Demonstrate improvements in Systems of Systems (SoS) analysis capability through virtual simulation mechanisms. Use metrics to show the value added proposition of multi-spectral techniques to address the threat to countermeasure system performance.			
Title: Evaluation of Advanced Countermeasure Concepts ***Description:*** Develop a core analytic function, supported by simulation-based wargaming and engineering modeling capabilities for evaluation, development, and demonstration of advanced electronic warfare (EW), cyber, directed energy (DE) and integrated/ systemic, non-kinetic concepts to include special capability programs. ***FY 2014 Accomplishments:*** Developed a core analytical function, supported by simulation based war gaming and engineering modeling capabilities for evaluation, development, and demonstration of advanced countermeasure concepts to include special capability programs. Expanded evaluation capabilities to incorporate full systemic electromagnetic spectrum (EMS) effects and netted/distributed EW capabilities in anti-access/area denial (A2/AD) scenarios. ***FY 2015 Plans:***	7.600	8.155	8.018

Exhibit R-2A, RDT&E Project Justification: PB 2016 Air Force		Date: February 2015
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603270F / *Electronic Combat Technology*	**Project (Number/Name)** 633720 / *EW Quick Reaction Capabilities*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Enhance in-house analysis and assessment capability to include current threat arrays and allow the analysis of distributed EW techniques against these systems. These include hardware in the loop (HWIL) and software in the loop (SWIL) enhancements for EW, electro-optical (EO) / infrared (IR) countermeasures, avionics vulnerability, and positioning, navigation, and timing (PNT). ***FY 2016 Plans:*** Demonstrate reconfigurable closed-loop HWIL assessment capability for discovering and evaluating advanced EW techniques, including diverse distributed concepts. The development of advanced techniques will ensure aircraft survivability against future threats with highly agile and adaptable waveform structures. Demonstrate in-house analysis and assessment technologies for countering A2/AD scenarios.			
Accomplishments/Planned Programs Subtotals	17.194	28.668	27.171

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2016 Air Force											Date: February 2015	
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603270F / *Electronic Combat Technology*				Project (Number/Name) 63431G / *RF Warning & Countermeasures Tech*			
COST ($ in Millions)	**Prior Years**	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**Cost To Complete**	**Total Cost**
63431G: *RF Warning & Countermeasures Tech*	-	20.692	14.484	15.800	-	15.800	15.671	15.284	15.237	15.539	Continuing	Continuing

A. Mission Description and Budget Item Justification

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: Electronic Attack	20.692	14.484	15.800
Description: Develop aerospace platform jamming technologies and techniques to counter advanced radio-frequency (RF) threats associated with current and future aerospace weapon systems. ***FY 2014 Accomplishments:*** Developed and demonstrated adaptable electronic attack (EA) technique concepts, cognitive jammer system concepts, and advanced EP concepts to defeat next generation RF threats with a major emphasis on penetrating contested, anti-access/area denial environments. ***FY 2015 Plans:*** Develop and conduct laboratory simulation experiments of adaptable EA technique concepts. Develop software prototype algorithms for cognitive jammer system concepts as well as protection of avionics systems to cyber-attacks. Continue to develop and demonstrate in laboratory environment advanced EP concepts to defeat next generation RF threats with a major emphasis on penetrating contested, anti-access/area denial scenarios. ***FY 2016 Plans:*** Leverage advances in cognitive machine learning to autonomously employ adaptable EA techniques against modern adaptive programmable threats. Develop techniques to ascertain the efficacy of advanced EA methods employed against modern threats to close the loop allowing optimization of the EA technique.			
Accomplishments/Planned Programs Subtotals	20.692	14.484	15.800

Exhibit R-2A, RDT&E Project Justification: PB 2016 Air Force		Date: February 2015
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603270F / *Electronic Combat Technology*	**Project (Number/Name)** 63431G / *RF Warning & Countermeasures Tech*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

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Exhibit R-2A, RDT&E Project Justification: PB 2016 Air Force			Date: February 2015
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / *Electronic Combat Technology*	Project (Number/Name) 63691X / *EO/IR Warning & Countermeasures Tech*	

COST ($ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
63691X: *EO/IR Warning & Countermeasures Tech*	-	4.630	4.356	4.061	-	4.061	5.032	4.926	4.857	4.953	Continuing	Continuing

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 infrared missiles with autonomous seekers, multi-spectral threats, laser-guided weapons, and EO/IR tracking systems used to direct EO/IR and radar-guided missiles.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: Advanced Electro-Optical (EO)/Infrared (IR) Warning and Countermeasure Technologies	4.630	4.356	4.061

Description: Analyze the vulnerabilities of current infrared (IR) missile systems and future imaging IR sensors. Develop advanced countermeasure system technologies to exploit vulnerabilities for use against IR and electro-optical (EO) guided missile threats. Develop advanced optical and infrared sensor systems for airborne and space situational awareness and threat warning.

FY 2014 Accomplishments:

Developed, tested, and refined infrared countermeasures concepts with emphasis on penetrating contested, anti-access/area denial environments. Developed surrogate imaging sensors, processors, and track algorithms and performed advance proactive infrared countermeasure (PIRCM) search, detect, and countermeasure research. Developed concepts for protection of postulated future threats to 6th generation aircraft, including definition of component and subsystem requirements.

FY 2015 Plans:

Develop advanced EO/IR concepts for protection from postulated future threats, including definition of component and subsystem requirements. Concepts will address contested, anti-access/area denial threats. Conduct laboratory experiments of surrogate multi-mode EO/IR sensors, processors, and track algorithms and continue to perform advanced proactive infrared countermeasure (PIRCM) search, detect, and countermeasure research.

FY 2016 Plans:

Continue the characterization and exploitation of advanced threat IR guided missiles and EO/IR Fire-control systems and sensors. Development of high fidelity surrogates, scene generation and modeling and simulation for testing and countermeasure development and verification/correlation to hardware in the loop results. Define the requirements for novel countermeasure

Exhibit R-2A, RDT&E Project Justification: PB 2016 Air Force		Date: February 2015
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603270F / *Electronic Combat Technology*	**Project (Number/Name)** 63691X / *EO/IR Warning & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
effects against advanced IR and multispectral threats. Conduct tests with advanced, next generation missile warning, hostile fire indication (HFI) and laser warning technologies.			
Accomplishments/Planned Programs Subtotals	4.630	4.356	4.061

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.