Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Air Force											Date: February 2016	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	-	126.729	178.594	94.594	0.000	94.594	104.499	112.332	116.482	118.570	Continuing	Continuing
632480: *Aerospace Fuels*	-	2.144	2.267	2.262	0.000	2.262	2.302	2.358	2.404	2.452	Continuing	Continuing
633035: *Aerospace Power Technology*	-	13.605	19.296	11.010	0.000	11.010	13.934	20.135	22.337	22.544	Continuing	Continuing
634921: *Aircraft Propulsion Subsystems Int*	-	51.389	77.791	19.757	0.000	19.757	17.902	18.194	18.539	18.909	Continuing	Continuing
634922: *Space & Missile Rocket Propulsion*	-	25.004	31.231	24.314	0.000	24.314	28.799	29.484	30.072	30.673	Continuing	Continuing
635098: *Advanced Aerospace Propulsion*	-	26.301	23.670	25.013	0.000	25.013	28.797	20.346	20.751	21.167	Continuing	Continuing
63681B: *Advanced Turbine Engine Gas Generator*	-	8.286	24.339	12.238	0.000	12.238	12.765	21.815	22.379	22.825	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to achieve enabling and revolutionary advances in turbine, advanced cycle, rocket, and space propulsion as well as electrical power, thermal management and fuels. The program has six projects, each focusing on technologies with a high potential to enhance the performance of existing and future Air Force weapons systems. The Aerospace Fuels project develops and demonstrates improved hydrocarbon fuels and advanced propulsion systems, including those for air-breathing high-speed/hypersonic flight. The Aerospace Power Technology project develops and demonstrates power and thermal management systems for high-power payloads and aircraft as part of energy-optimized aircraft development. The Aircraft Propulsion Subsystems Integration project integrates the engine cores demonstrated in the Advanced Turbine Engine Gas Generator project with low-pressure components into demonstrator engines. The Space and Missile Rocket Propulsion project develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques. The Advanced Aerospace Propulsion project develops the scramjet propulsion cycle to a technology readiness level appropriate for in-flight demonstration and for full integration with other engine cycles (including turbine and rocket based). The Advanced Turbine Engine Gas Generator project develops and demonstrates core turbine engine technologies for current and future aircraft propulsion systems. Portions of the Aerospace Fuels, Advanced Turbine Engine Gas Generator, and Aerospace Propulsion Subsystems Integration projects support adaptive cycle technology demonstrations, which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs. Efforts in this program have 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.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	132.681	168.821	94.717	0.000	94.717
Current President's Budget	126.729	178.594	94.594	0.000	94.594
Total Adjustments	-5.952	9.773	-0.123	0.000	-0.123
• Congressional General Reductions	0.000	-0.227			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	10.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-2.071	0.000			
• SBIR/STTR Transfer	-3.881	0.000			
• Other Adjustments	0.000	0.000	-0.123	0.000	-0.123

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: 633035: *Aerospace Power Technology*		
Congressional Add: *Silicon Carbide Research*	8.500	10.000
Congressional Add Subtotals for Project: 633035	8.500	10.000
Congressional Add Totals for all Projects	8.500	10.000

Change Summary Explanation

Decrease in FY 2015 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2358.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force			Date: February 2016
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 632480 / *Aerospace Fuels*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
632480: *Aerospace Fuels*	-	2.144	2.267	2.262	0.000	2.262	2.302	2.358	2.404	2.452	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project evaluates and demonstrates improved hydrocarbon fuels, unique special application fuels, alternate fuels and advanced, novel aerospace propulsion technologies for Air Force applications, including high-speed and hypersonic flight and technologies to increase turbine engine operational reliability, durability, mission flexibility, and performance, while reducing weight, fuel consumption, and cost of ownership. The advanced fuel emphasis is on demonstrating new thermally stable, high-heat sink, and controlled chemically reacting fuels for a conventional turbine engine, turbine-based combined cycle engines, and other advanced propulsion systems. The project also evaluates and demonstrates fuel system components that minimize cost, reduce maintenance, and improve performance of future aerospace systems. The advanced propulsion emphasis is on demonstrating concepts for combined cycle, ramjet, and scramjet engines. A portion of this project supports the demonstration of adaptive cycle technologies. This project develops component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Fuel-Related Thermal Management	0.594	0.627	0.662
Description: Demonstrate thermally stable fuels and fuel system hardware concepts to enhance cooling capacity (performance), minimize fuel coking, and reduce fuel system maintenance.			
FY 2015 Accomplishments: Demonstrated heat sink and coking performance of advanced producible endothermic fuel.			
FY 2016 Plans: Demonstrate nano-catalysts/nano-additives for enhancing heat sink and reducing coking.			
FY 2017 Plans: Investigate adaptable heat sink alternatives for advanced thermal management.			
Title: Gas Turbine Combustion, Emissions, and Performance	0.594	0.628	0.600
Description: Develop and demonstrate efficacy of low-cost, environmentally friendly fuel approaches to assess and reduce soot/ particulate emissions from gas turbine engines.			
FY 2015 Accomplishments: Demonstrated advanced particulate characterization enabling the identification and quantification of particulates absorbed in volatile and non-volatile hydrocarbon fuels.			
FY 2016 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 632480 / *Aerospace Fuels*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Assess operability in referee combustor of reference jet fuels representing range of conventional jet fuels being used by Air Force. ***FY 2017 Plans:*** Support industry combustor model development by supplying referee combustor validation data.			
Title: Fuel Logistics ***Description:*** Identify, develop, and demonstrate low-cost approaches to reducing the fuel logistics footprint for the Air Force. ***FY 2015 Accomplishments:*** Continued bio-contamination, mitigation and risk assessment of aviation fuels. Continued to demonstrate and evaluate commercial conversion impacts and fuel filtration devices with nano-size meshes to mitigate biological growth in aviation fuels. ***FY 2016 Plans:*** Continue bio-contamination, mitigation and risk assessment of aviation fuels. Demonstrate anti-microbial peptides and biological active control for mitigating biological growth in aviation fuels. ***FY 2017 Plans:*** Continue analysis of the benefits of additives in commercial aviation jet fuel for military use and potential for additive removal.	0.767	0.812	0.800
Title: Alternative Jet Fuels ***Description:*** Characterize and demonstrate the use of alternative hydrocarbon jet fuel to comply with Air Force certifications and standards for jet fuels. ***FY 2015 Accomplishments:*** Approved military use of alternative fuels added to commercial aviation jet fuel specifications. Continued analysis of approaches for evaluating and approving alternative jet fuels added to commercial jet aviation fuel specifications. ***FY 2016 Plans:*** Continue analysis of approaches for evaluating and approving alternative jet fuels added to commercial jet aviation fuel specifications. ***FY 2017 Plans:*** Continue analysis of new approaches for evaluating and approving alternative jet fuels added to commercial jet aviation fuel specifications.	0.189	0.200	0.200
Accomplishments/Planned Programs Subtotals	2.144	2.267	2.262

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 632480 / *Aerospace Fuels*

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 2017 Air Force			Date: February 2016
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 633035 / *Aerospace Power Technology*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
633035: *Aerospace Power Technology*	-	13.605	19.296	11.010	0.000	11.010	13.934	20.135	22.337	22.544	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates electrical power, thermal management, and distribution for aerospace applications. This project develops and demonstrates the electrical power and thermal management components, controls and systems required to satisfy the needs of current and future aircraft as well as to enable the use of future high-power payloads. This technology enhances reliability and survivability, and reduces vulnerability, weight, and life cycle costs of air platforms. The electrical power system components provide a two- fold to five-fold improvement in aircraft reliability and maintainability, and a reduction in power system weight. This project integrates into energy optimized aircraft efforts and power and thermal programs.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: High Power Aircraft Subsystem Technologies	5.105	9.296	11.010
Description: Develop and demonstrate integrated architecture controls, and components for power generation, conditioning, and distribution; energy storage components; and thermal management and subsystem technologies for integration into high power aircraft. ***FY 2015 Accomplishments:*** Continued development and demonstration of system and component electrical power, electro-mechanical, and thermal technologies for high-power aircraft. Continued demonstration of platform-level hardware-in-the-loop integrated power and thermal management subsystems. Initiated development of actuation technology for applications with power, volume, and thermal limitations. ***FY 2016 Plans:*** Continue development and demonstration of system and component electrical power, electro-mechanical, and thermal technologies for high-power aircraft. Complete demonstration of platform-level hardware-in-the-loop integrated power and thermal management subsystems. Continue development of actuation technology for applications with power, volume, and thermal limitations. Initiate the development of hybrid-cycle power and thermal management system. Initiate development of advanced power generation and distribution system. ***FY 2017 Plans:*** Continue development and demonstration of system and component electrical power, electro-mechanical, and thermal technologies for high-power aircraft. Continue development of actuation technology for applications with power, volume, and thermal limitations. Continue the development of hybrid-cycle power and thermal management system. Continue development of			

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 633035 / *Aerospace Power Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
advanced power generation and distribution system. Initiate development and demonstration of an integrated power and thermal system for a high-power payload, e.g. laser weapon demonstration.			
Accomplishments/Planned Programs Subtotals	5.105	9.296	11.010

	FY 2015	FY 2016
Congressional Add: Silicon Carbide Research	8.500	10.000
FY 2015 Accomplishments: Conducted Congressionally directed efforts		
FY 2016 Plans: Conduct Congressionally directed efforts		
Congressional Adds Subtotals	8.500	10.000

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 2017 Air Force			Date: February 2016
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 634921 / *Aircraft Propulsion Subsystems Int*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
634921: *Aircraft Propulsion Subsystems Int*	-	51.389	77.791	19.757	0.000	19.757	17.902	18.194	18.539	18.909	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. The Aerospace Propulsion Subsystems Integration (APSI) project includes demonstrator engines for manned systems and concept and efficient small-scale propulsion for remotely piloted aircraft and cruise missile applications. The demonstrator engines integrate the core (high-pressure spool) technology developed under the Advanced Turbine Engine Gas Generator (ATEGG) project with the engine (low-pressure spool) technology such as fans, turbines, engine controls, mechanical systems, exhaust nozzles, and augmentors. Additionally, this project includes activities to improve propulsion safety and readiness. This project also focuses on integration of inlets, nozzles, engine-to-airframe compatibility, and power and thermal management subsystemstechnologies. The APSI project provides aircraft with potential for longer range and higher cruise speeds with lower specific fuel consumption, surge power for successful engagements, high sortie rates with reduced maintenance, reduced life cycle cost, and improved survivability, resulting in increased mission effectiveness. Technologies developed are applicable to sustained high-speed vehicles and responsive space launch. The APSI project is focused on improving propulsion capabilities while at the same time reducing the cost of ownership. Anticipated technology advances include turbine engine improvements providing approximately twice the range for a sustained supersonic combat aircraft, doubling the time on station with ten times the power output for surveillance aircraft and propulsion for a high speed supersonic missile with double the range for time sensitive targets. A portion of this project supports the demonstration of adaptive cycle technologies, which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Missile/Remotely Piloted Aircraft Engine Performance	13.649	20.687	11.757
Description: Design, fabricate, and test component technologies for limited-life engines to improve the performance, durability, and affordability of missile and remotely piloted aircraft engines.			
FY 2015 Accomplishments: Completed initial ground testing of demonstration supersonic, long endurance turbine engines at simulated altitude conditions. Completed testing of advanced components for engine technology applicable to missiles and unmanned vehicles. Completed detailed design and begin fabrication and instrumentation of a subsonic small turbine engine technology experimental test.			
FY 2016 Plans: Complete final ground testing of demonstration supersonic, long endurance turbine engines at simulated altitude conditions. Complete fabrication and instrumentation of a subsonic small turbine engine technology experimental test. Complete detailed design of subsonic mid-sized turbine engine technology for remotely piloted aircraft.			
FY 2017 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 634921 / *Aircraft Propulsion Subsystems Int*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Conduct ground test of subsonic small turbine engine for missile application. Increase effort in efficient limited-life medium scale propulsion development for future Intelligence, Surveillance, and Reconnaissance (ISR) and strike capability.			
Title: Adaptive Turbine Engine Technologies ***Description:*** Design, fabricate, and demonstrate performance, durability, and operability technologies to mature adaptive turbine engine technologies. ***FY 2015 Accomplishments:*** Completed preliminary design reviews and initiate detailed design of an adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Continued engine technology development activity to support core engine assembly and initial ground testing. Continue to instrument and assemble core experimental adaptive turbine engines. ***FY 2016 Plans:*** Complete the instrumentation and assembly of core experimental adaptive turbine engines. Initiate and complete ground testing of core experimental adaptive turbine engines. Initiate and complete the assessment of the acquired and processed data from the ground testing of core experimental adaptive turbine engines and comparison to analytical prediction tools to validate reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. ***FY 2017 Plans:*** Support successful technology transition to potential 6.4 program.	37.740	57.104	8.000
Accomplishments/Planned Programs Subtotals	51.389	77.791	19.757

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 2017 Air Force			Date: February 2016
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 634922 / *Space & Missile Rocket Propulsion*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
634922: *Space & Missile Rocket Propulsion*	-	25.004	31.231	24.314	0.000	24.314	28.799	29.484	30.072	30.673	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced and innovative low-cost rocket turbo-machinery and components, and low-cost space launch propulsion technologies. Additionally, this project develops technologies for the sustainment of strategic systems (including solid rocket motor boosters and missile propulsion, post boost control, and aging and surveillance efforts) and tactical rockets. Characteristics such as environmental acceptability, affordability, reliability, responsiveness, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion technologies, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy propellants. Technological advances in this program could improve the performance of expendable payload capabilities by approximately twenty to fifty percent and reduce launch, operations, and support costs by approximately thirty percent. Responsiveness and operability of propulsion systems will be enhanced for reusable launch systems. Aging and surveillance efforts for solid rocket motors could reduce lifetime prediction uncertainties for individual motors by fifty percent, enabling motor replacement for cause. The efforts in this project contribute to the sustainment of the rocket propulsion industry, providing rocket propulsion technology for the entire DoD and National Aeronautics and Space Administration (NASA). The project efforts are part of the Rocket Propulsion 21 (RP21) program. The project efforts are reviewed by a DoD level steering committee annually for relevance to DoD missions and achievement of technical goals defined by the RP21 program.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Liquid Rocket Propulsion Technologies	18.451	23.057	17.776
Description: Develop liquid rocket propulsion technology for current and future space launch vehicles.			
FY 2015 Accomplishments: Continued development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept applicable to future expendable and reusable launch vehicles. Completed sub-scale preburner and completed sub-scale turbine component testing to demonstrate hydrocarbon boost technologies. Completed thrust chamber sub-scale development and test device. Continued full-scale pre-burner component development, conducted Preliminary Design Review (PDR), Critical Design Review (CDR), and began fabrication of test article. Conducted PDR on the full-scale turbopump design. Continued design of thrust chamber assembly and conducted PDR of the full-scale design.			
FY 2016 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 634922 / *Space & Missile Rocket Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Continue development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept applicable to future expendable and reusable launch vehicles. Continue fabrication of full-scale preburner and begin testing the component. Conduct CDR on the Thrust Chamber and begin fabrication. ***FY 2017 Plans:*** Continue development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept applicable to future expendable and reusable launch vehicles. Complete CDR for the full-scale Turbopump and begin fabrication. Complete fabrication of the full-scale Thrust Chamber and begin testing. Conduct the PDR for the integrated demonstration engine.			
Title: Ballistic Missile Technologies ***Description:*** Develop and demonstrate missile propulsion and post-boost control systems technologies for ballistic missiles. ***FY 2015 Accomplishments:*** Continued to develop advanced missile case, insulation, and nozzle technologies. Continued validation of modeling and simulation tools. ***FY 2016 Plans:*** Continue to develop advanced missile case, insulation, and nozzle technologies. Continue validation of modeling and simulation tools through upcoming demonstration. ***FY 2017 Plans:*** Begin technology demonstration effort on advanced missile case, insulation, and nozzle technologies and validation of physics-based modeling, simulation, and analysis tools. Begin technology demonstration effort of post-boost technologies.	3.991	6.054	4.777
Title: Strategic System Motor Surveillance ***Description:*** Develop and demonstrate aging and surveillance technologies for strategic systems to reduce lifetime prediction uncertainty for individual motors, enabling motor replacement for cause. ***FY 2015 Accomplishments:*** Continued development of next generation of sensors used for aging and surveillance. Supported transition of previous tools, models, and data management system to user. Continued sub-scale motors dissection to validate the sensor and analytical analysis of each motor. ***FY 2016 Plans:*** Apply next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and	2.562	2.120	1.761

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 634922 / *Space & Missile Rocket Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
non-destructive analysis tools. Continue advanced sensor development efforts to further improve data acquisition and reduce uncertainty in ballistic missile life predictions. Improve the fidelity and precision of non-destructive evaluation tools to increase capability to determine flaw size, orientation, and location. Support transition of previous tools, models, data management system to user. Begin long-term validation of tools through long-term aging of sub-scale motors. Continue sub-scale motors dissection to validate the sensor and analytical analysis of each motor. ***FY 2017 Plans:*** Continue to apply next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and non-destructive analysis tools. Continue advanced sensor development efforts to further improve data acquisition and reduce uncertainty in ballistic missile life predictions. Continue to improve the fidelity and precision of non-destructive evaluation tools to increase the capability to determine flaw size, orientation, and location. Support transition of previous tools, models, data management system to user. Continue long-term validation of tools through long-term aging of sub-scale motors. Continue sub-scale motors dissection to validate the sensor and analytical analysis of each motor.			
Accomplishments/Planned Programs Subtotals	25.004	31.231	24.314

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 2017 Air Force			Date: February 2016
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 635098 / *Advanced Aerospace Propulsion*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
635098: *Advanced Aerospace Propulsion*	-	26.301	23.670	25.013	0.000	25.013	28.797	20.346	20.751	21.167	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates, via ground and flight tests, the scramjet propulsion cycle to a technology readiness level appropriate for full integration with other engine cycles (including turbine and rocket-based) to provide the Air Force with transformational military capabilities. The primary focus is on the hydrocarbon-fueled, scramjet engine. Multi-cycle engines will provide the propulsion systems for possible application to support aircraft and weapon platforms operating up to Mach 7. Efforts include: scramjet flow-path optimization to enable operation over the widest possible range of Mach numbers; active combustion control to assure continuous positive thrust (even during mode transition); robust flame-holding to maintain stability through flow distortions; and maximized volume-to-surface area to minimize the thermal load imposed by the high-speed engine. Thermal management plays a vital role in scramjet and combined cycle engines, including considerations for protecting low speed propulsion systems (e.g., turbine engines) during hypersonic flight.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Scramjet Technologies	26.301	23.670	25.013
Description: Develop and demonstrate technologies for a hydrocarbon-fueled scramjet with robust operation up to Mach 7.			
FY 2015 Accomplishments: Continued development and demonstration of tactically compliant subsystems, including scramjet engine start system, fuel system, and engine controls. Initiated testing of flight weight ground test engine to demonstrate tactically compliant cold start system. Continued additional component development and testing for insensitive munition compliant scramjet cold start system in both X-51 heritage, two-dimensional, engine lines and axisymmetric, three-dimensional, scramjet flow lines. Conducted ground test of flight weight engine components for High Speed Strike Weapon demonstration and supported PDR.			
FY 2016 Plans: Continue development and demonstration of tactically compliant subsystems, including scramjet engine start system, fuel system, and engine controls. Complete additional component development and testing for insensitive munition compliant scramjet cold start system in both X-51 heritage, two-dimensional, engine lines and axisymmetric, three-dimensional, scramjet flow lines. Design flight weight cold start system for demonstration in direct-connect test hardware. Develop scramjet technologies to enhance operability including robust operation during maneuvers. Continue accelerated development and demonstration of tactically-relevant long range high speed strike scramjet engine technologies including ground and flight demonstrations needed for potential follow-on acquisition program. Initiate detailed design of scramjet engine for air breathing weapon concept.			
FY 2017 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 635098 / *Advanced Aerospace Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Continue development and demonstration of tactically compliant subsystems, including scramjet engine start system, fuel system, and engine controls. Complete additional component development and testing for insensitive munition compliant scramjet cold start system in both X-51 heritage, two-dimensional, engine lines and axisymmetric, three-dimensional, scramjet flow lines. Initiate direct-connect test of tactically compliant cold start system in flight weight hardware. Continue development of scramjet technologies to enhance operability including robust operation during maneuvers. Continue accelerated development and demonstration of tactically-relevant long range high speed strike scramjet engine technologies including ground and flight demonstrations needed for potential follow-on acquisition program. Initiate fabrication of scramjet engine for air breathing weapon concept.			
Accomplishments/Planned Programs Subtotals	26.301	23.670	25.013

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 2017 Air Force			Date: February 2016
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 63681B / *Advanced Turbine Engine Gas Generator*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
63681B: *Advanced Turbine Engine Gas Generator*	-	8.286	24.339	12.238	0.000	12.238	12.765	21.815	22.379	22.825	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. The objective is to provide continuous evolution of technologies into an advanced gas generator in which the performance, cost, durability, repairability, and maintainability can be assessed in a realistic engine environment. The gas generator, or core, is the basic building block of the engine and nominally consists of a compressor, a combustor, a high-pressure turbine, mechanical systems, and core subsystems. Experimental core engine demonstration validates engineering design tools and enhances rapid, low-risk transition of key engine technologies into engineering development, where they can be applied to derivative and/or new systems. These technologies are applicable to a wide range of military and commercial systems including aircraft, missiles, land combat vehicles, ships, and responsive space launch. Component technologies are demonstrated in a core (sub-engine). This project also assesses the impact of low spool components such as; inlet systems, fans, low pressure turbines, exhaust systems, and system level technologies such as; integrated power generators and thermal management systems on core engine performance, and durability in ground demonstrations of engine cores. The core performances of this project are validated on demonstrator engines in the Aerospace Propulsion Subsystems Integration (APSI) Project of this program. A portion of this project supports the demonstration of adaptive cycle technologies, which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Core Engine Technologies	2.827	8.310	5.238
Description: Design, fabricate, and demonstrate performance predictions in core engines, using innovative engine cycles and advanced materials for turbofan and for turbojet engines. ***FY 2015 Accomplishments:*** Continued fabrication of hardware components enabling increased reliability, maintainability, and affordability for ground engine core demonstration. Completed full annular combustor rig demonstration. ***FY 2016 Plans:*** Continue instrumentation and assembly of component hardware for rig demonstration and validation of increased reliability, maintainability, and affordability. Complete design and fabrication of remaining components for core demonstration for potential acquisition program for transition to fielded systems. ***FY 2017 Plans:*** Finish assembly, instrumentation and test of core engine. Begin design of medium-scale efficient core demonstrator.			
Title: High Pressure Ratio Core Engine Technologies	0.308	0.904	1.900

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 63681B / *Advanced Turbine Engine Gas Generator*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Description: Design, fabricate, and demonstrate high overall pressure ratio engine cores to provide increased durability and affordability with lower fuel consumption for turbofan and for turboshaft engines. ***FY 2015 Accomplishments:*** Initiated risk reduction rig tests of components of small efficient engine core concepts with advanced technologies such as high pressure ratios, high temperature capability compressors, high heat release combustors, and high cooling effectiveness turbine with an integrated thermal management system and advanced mechanical systems. ***FY 2016 Plans:*** Complete risk reduction rig testing of components for small efficient engine core concepts with advanced technologies such as high pressure ratio/high temperature capability compressors, high heat release combustors, high cooling effectiveness turbine with an integrated thermal management system, and advanced mechanical systems. ***FY 2017 Plans:*** Complete data reduction of test data for potential follow-on transition to ground engine demonstration or for fielded systems.			
Title: Adaptive Turbine Engine Core Technologies ***Description:*** Design, fabricate, and demonstrate adaptive turbine engine cores to provide increased durability and affordability with lower fuel consumption for turbofan and for turboshaft engines. ***FY 2015 Accomplishments:*** Completed detailed design of some engine core technologies and continued others for application to adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Initiated hardware procurement and manufacturing of core components and technologies for transition to experimental engine core demonstration. ***FY 2016 Plans:*** Complete fabrication, instrumentation, and assembly of components for experimental engine core demonstration of an adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Initiate experimental engine core demonstration of an adaptive turbine engine and critical component rig tests. Begin conceptual design for air dominance adaptive core demonstrator. ***FY 2017 Plans:*** Finish manufacturing and begin assembly of core demonstrator. Begin preliminary design for advanced air dominance adaptive core demonstrator.	5.151	15.125	5.100
Accomplishments/Planned Programs Subtotals	8.286	24.339	12.238

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 63681B / *Advanced Turbine Engine Gas Generator*

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.

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