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 0603216F / *Aerospace Propulsion and Power 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	-	160.765	132.681	168.821	-	168.821	94.717	98.118	107.344	112.610	Continuing	Continuing
632480: *Aerospace Fuels*	-	2.380	2.274	2.270	-	2.270	2.262	2.302	2.343	2.389	Continuing	Continuing
633035: *Aerospace Power Technology*	-	17.301	13.915	9.306	-	9.306	8.010	9.934	10.135	10.337	Continuing	Continuing
634921: *Aircraft Propulsion Subsystems Int*	-	67.879	53.651	77.889	-	77.889	19.757	17.902	23.284	25.647	Continuing	Continuing
634922: *Space & Missile Rocket Propulsion*	-	23.362	26.540	31.280	-	31.280	24.288	28.778	29.421	30.007	Continuing	Continuing
635098: *Advanced Aerospace Propulsion*	-	18.194	27.240	23.720	-	23.720	25.013	22.797	20.346	20.751	Continuing	Continuing
63681B: *Advanced Turbine Engine Gas Generator*	-	31.649	9.061	24.356	-	24.356	15.387	16.405	21.815	23.479	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 weapons 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 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 0603216F / *Aerospace Propulsion and Power Technology*		
B. Program Change Summary ($ in Millions)	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**
Previous President's Budget	159.291	124.236	164.953	-	164.953
Current President's Budget	160.765	132.681	168.821	-	168.821
Total Adjustments	1.474	8.445	3.868	-	3.868
• Congressional General Reductions	-	-0.055			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	8.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	5.813	-			
• SBIR/STTR Transfer	-4.339	-			
• Other Adjustments	-	-	3.868	-	3.868

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2014	FY 2015
Project: 633035: *Aerospace Power Technology*		
Congressional Add: *Silicon Carbide Research*	10.000	8.500
Congressional Add Subtotals for Project: 633035	10.000	8.500
Congressional Add Totals for all Projects	10.000	8.500

Change Summary Explanation

FY2016 increase due to higher DoD priorities to include Adaptive Engine Technology Development(AETD)Program risk reduction efforts.

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 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 632480 / *Aerospace Fuels*	

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
632480: *Aerospace Fuels*	-	2.380	2.274	2.270	-	2.270	2.262	2.302	2.343	2.389	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 2014	FY 2015	FY 2016
Title: Fuel-Related Thermal Management	0.331	0.630	0.628
Description: Demonstrate thermally stable fuels and fuel system hardware concepts to enhance cooling capacity (performance), minimize fuel coking, and reduce fuel system maintenance.			
FY 2014 Accomplishments: Demonstrated fuel-cooled thermal management approaches for variable-cycle engines.			
FY 2015 Plans: Demonstrate 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.			
Title: Gas Turbine Combustion, Emissions, and Performance	0.331	0.630	0.629
Description: Develop and demonstrate efficacy of low-cost, environmentally friendly fuel approaches to assess and reduce soot/ particulate emissions from gas turbine engines.			
FY 2014 Accomplishments: Demonstrated international standard methodology for measuring soot (particulates) on a variety of gas turbine engines. This measurement methodology will be transitioned through publication as a recommended international aerospace practice.			
FY 2015 Plans:			

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 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 632480 / *Aerospace Fuels*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Demonstrate advanced particulate characterization enabling the identification and quantification of particulates absorbed in volatile and non-volatile hydrocarbon fuels. ***FY 2016 Plans:*** Assess operability in referee combustor of reference jet fuels representing range of conventional jet fuels being used by Air Force.			
Title: Fuel System Technologies ***Description:*** Develop and demonstrate enhancements to fuel system technology. ***FY 2014 Accomplishments:*** Demonstrated effectiveness of enhanced endothermic fuel under higher heat sink conditions in reduced scale cooling simulations. This effort completed in FY14. ***FY 2015 Plans:*** N/A ***FY 2016 Plans:*** N/A	0.331	-	-
Title: Fuel Logistics ***Description:*** Identify, develop, and demonstrate low-cost approaches to reducing the fuel logistics footprint for the Air Force. ***FY 2014 Accomplishments:*** Evaluated impact of commercial aviation jet fuel conversion (including alternative fuels) on Air Force fuel infrastructure. ***FY 2015 Plans:*** Continue to demonstrate and evaluate commercical conversion impacts and fuel filtration devices with nano-size meshes to mitigate biological growth in aviation fuels. ***FY 2016 Plans:*** Demonstrate anti-microbial peptides and biological active control for mitigating biological growth an aviation fuels.	0.529	0.814	0.813
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 2014 Accomplishments:***	0.858	0.200	0.200

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 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 632480 / *Aerospace Fuels*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Evaluated storage, distribution, ignition, combustion, and other properties of cellulosic-based alternative aviation fuels produced through fermentation processes. Supported interagency combustor operability testing. Published research reports for industry review to faciliate development of consistent and common military and commercial fuel specifications. Supported interagency combustor operability testing. ***FY 2015 Plans:*** Complete combustor operability study with low-temperature fuel-air ignition and re-light investigation for reference fuels and fuels that are 100% synthetic. Continue to evaluate cellulosic-based alternative aviation fuels produced through fermentation processes. ***FY 2016 Plans:*** Demonstrate combustion performance/operability of advanced cellulosic alternative fuels being considered for addition to Jet A specification (ASTM D7566), which Air Force will use due for conversion to Jet A/F-24.			
Accomplishments/Planned Programs Subtotals	2.380	2.274	2.270

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 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 633035 / *Aerospace Power 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
633035: *Aerospace Power Technology*	-	17.301	13.915	9.306	-	9.306	8.010	9.934	10.135	10.337	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 technologies 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 developed are projected to provide a two- fold to five-fold improvement in aircraft reliability and maintainability, and a reduction in power system weight. This project is integrated into energy optimized aircraft efforts and power and thermal programs.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: High Power Aircraft Subsystem Technologies	7.301	5.415	9.306
Description: Develop and demonstrate integrated architecture and components for power generation, conditioning, and distribution; energy storage components; and thermal management and subsystem technologies for integration into high power aircraft.			
FY 2014 Accomplishments: Completed demonstration of adapative power and thermal management components for next generation air platforms and initiated integration of power and thermal management subsystems for platform-level hardware-in-the-loop energy optimization demonstration. Facilitated technology and hardware integration for demonstration. Completed design work and initiated component subsystem testing.			
FY 2015 Plans: Continue development and demonstration of system and component electrical power, electro-mechanical, and thermal technologies for high-power aircraft. Continue demonstration of platform-level hardware-in-the-loop integrated power and thermal management subsystems. Initiate development of actuation technology for applications with power, volume, and thermal limitations. Initiate development of hybrid-cycle power and thermal management system.			
FY 2016 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 development of hybrid-cycle power and thermal management system. Complete demonstration			

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 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 633035 / *Aerospace Power Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
of platform-level hardware-in-the-loop integrated power and thermal management. Initiate development of advanced power generation and distribution system.			
Accomplishments/Planned Programs Subtotals	7.301	5.415	9.306

	FY 2014	FY 2015
Congressional Add: Silicon Carbide Research	10.000	8.500
FY 2014 Accomplishments: Conducted Congressionally directed efforts		
FY 2015 Plans: Conduct Congressionally directed efforts		
Congressional Adds Subtotals	10.000	8.500

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 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 634921 / *Aircraft Propulsion Subsystems Int*	

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
634921: *Aircraft Propulsion Subsystems Int*	-	67.879	53.651	77.889	-	77.889	19.757	17.902	23.284	25.647	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 2014	FY 2015	FY 2016
Title: Turbofan/Turbojet Durability	0.200	-	-
Description: Design, fabricate, and demonstrate durability and integration technologies for turbofan engines and for turbojet engines to improve durability, supportability, and affordability of Air Force aircraft. ***FY 2014 Accomplishments:*** Completed inlet and exhaust interaction study and demonstrated health monitor technologies. This effort completed in FY14. ***FY 2015 Plans:*** N/A ***FY 2016 Plans:*** N/A			
Title: Missile/Remotely Piloted Aircraft Engine Performance	18.428	14.250	20.713

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 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 634921 / *Aircraft Propulsion Subsystems Int*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
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 2014 Accomplishments:*** Accelerated engine activity to meet follow on need date. Continued rig testing of advanced components for engine technology applicable to subsonic missiles or unmanned vehicles. Continued detailed design of subsonic small turbine engine technology. Began preliminary design of subsonic mid-sized turbine engine technology for remotely piloted aircraft. ***FY 2015 Plans:*** Complete ground testing of demonstration supersonic, long endurance turbine engines at simulated altitude conditions. Complete testing of advanced components for engine technology applicable to missiles and unmanned vehicles. Complete detailed design and begin fabrication and instrumentation of a subsonic small turbine engine technology experimental test. ***FY 2016 Plans:*** 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.			
Title: Adaptive Turbine Engine Technologies ***Description:*** Design, fabricate, and demonstrate performance, durability, and operability technologies to mature adaptive turbine engine technologies. ***FY 2014 Accomplishments:*** Completed preliminary designs for an adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Initiated manufacturing of advanced adaptive fan, augmentor, and exhaust rig test hardware. Continued engine technology development activity to support component instrumentation and integration into core engine. ***FY 2015 Plans:*** Complete preliminary design reviews and initiate detailed design of an adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Continue engine technology development activity to support core engine assembly and initial ground testing. ***FY 2016 Plans:*** Instrument, assemble, and complete core experimental ground testing of an adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost.	49.251	39.401	57.176
Accomplishments/Planned Programs Subtotals	67.879	53.651	77.889

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 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 634921 / *Aircraft Propulsion Subsystems Int*

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 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 634922 / *Space & Missile Rocket Propulsion*	

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
634922: *Space & Missile Rocket Propulsion*	-	23.362	26.540	31.280	-	31.280	24.288	28.778	29.421	30.007	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 developed 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 Department of Defense and 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 2014	FY 2015	FY 2016
Title: Liquid Rocket Propulsion Technologies	17.746	20.034	23.601
Description: Develop liquid rocket propulsion technology for current and future space launch vehicles.			
FY 2014 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. Continued sub-scale preburner and continued sub-scale turbine component testing to demonstrate hydrocarbon boost technologies. Continued thrust chamber sub-scale development. Continued full-scale pre-burner component development.			
FY 2015 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 sub-scale preburner and complete sub-scale turbine component testing to demonstrate hydrocarbon boost technologies. Complete thrust chamber sub-scale development and test device. Continue full-scale pre-burner component development, conduct Preliminary Design Review, Critical Design Review,			

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 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 634922 / *Space & Missile Rocket Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
and begin fabrication of test article. Conduct Preliminary Design Review on the full-scale turbopump design. Continue design of thrust chamber assembly and conduct Preliminary Design Review and Critical Design Review of the full-scale design. ***FY 2016 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. Continue fabrication of full-scale preburner and begin testing the component. Conduct Critical Design Review on the full-scale turbopump design and begin fabrication. Begin fabrication of thrust chamber assembly.			
Title: Ballistic Missile Technologies ***Description:*** Develop and demonstrate missile propulsion and post-boost control systems technologies for ballistic missiles. ***FY 2014 Accomplishments:*** Continued development and prototyping of advanced missile case, insulation, and nozzle technologies. Continued validation of modeling and simulation tools. ***FY 2015 Plans:*** Continue to develop advanced missile case, insulation, and nozzle technologies. Continue 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.	3.320	4.456	5.264
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 2014 Accomplishments:*** Completed integration and full-scale demonstration of advanced aging and surveillance tools into solid rocket motors to validate and verify modeling and simulation tools and component technologies. Began development of next generation of sensors used for aging and surveillance. ***FY 2015 Plans:***	2.296	2.050	2.415

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 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 634922 / *Space & Missile Rocket Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Continue development of next generation of sensors used for aging and surveillance. Support transition of previous tools, models, and data management system to user. ***FY 2016 Plans:*** 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. Improve the fidelity and precision of non-destructive evaluation tools, improving 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. Sub-scale motors will be periodically dissected over the next seven years to validate the sensor and analytical analysis of each motor.			
Accomplishments/Planned Programs Subtotals	23.362	26.540	31.280

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 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 635098 / *Advanced Aerospace Propulsion*	

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
635098: *Advanced Aerospace Propulsion*	-	18.194	27.240	23.720	-	23.720	25.013	22.797	20.346	20.751	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 2014	FY 2015	FY 2016
Title: Scramjet Technologies	18.194	27.240	23.720
Description: Develop and demonstrate technologies for a hydrocarbon-fueled scramjet with robust operation up to Mach 7.			
FY 2014 Accomplishments: Continued development and demonstration of tactically compliant subsystems, including scramjet engine start system, fuel system, and engine controls. Initiated additional component development and testing for insensitive munition compliant scramjet cold start system after difficulty attaining reliable scramjet ignition within strict time requirements. Designed and initiated fabrication of ground test flight weight engine components for High Speed Strike Weapon demonstration.			
FY 2015 Plans: Continue development and demonstration of tactically compliant subsystems, including scramjet engine start system, fuel system, and engine controls. Initiate testing of flight weight ground test engine to demonstrate tactically compliant cold start system. Continue 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-dimenstional, scramjet flow lines. Conduct ground test of flight weight engine components for High Speed Strike Weapon demonstration and support preliminary design review.			
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 and initiate free-jet test hardware. Continue accelerated development and demonstration of			

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 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 635098 / *Advanced Aerospace Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
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.			
Accomplishments/Planned Programs Subtotals	18.194	27.240	23.720

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 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 63681B / *Advanced Turbine Engine Gas Generator*	

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
63681B: *Advanced Turbine Engine Gas Generator*	-	31.649	9.061	24.356	-	24.356	15.387	16.405	21.815	23.479	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 the continued 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 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 2014	FY 2015	FY 2016
Title: Core Engine Technologies	11.030	3.091	8.316
Description: Design, fabricate, and demonstrate performance predictions in core engines, using innovative engine cycles and advanced materials for turbofan and for turbojet engines.			
FY 2014 Accomplishments: Continued testing of an engine core with engine durability technology for demonstration. Based on test data, refined development and fabrication of component technologies for increased reliability, maintainability, and affordability for potential transition to fielded systems. Initiated durability testing of component technologies.			
FY 2015 Plans: Complete fabrication of hardware components enabling increased reliability, maintainability, and affordability for potential follow-on ground engine demonstration or potential acquisition program for transition to fielded systems.			
FY 2016 Plans:			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Instrument and assemble hardware for core demonstration and validation of increased reliability, maintainability, and affordability for potential follow-on ground engine demonstration or potential acquisition program for transition to fielded systems.			
Title: High Pressure Ratio Core Engine Technologies ***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 2014 Accomplishments:*** Continued detailed design 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 2015 Plans:*** Initiate 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.	1.200	0.337	0.905
Title: Adaptive Turbine Engine Core Technologies ***Description:*** Design, fabricate, and demonstrate high overall pressure ratio cores to provide increased durability and affordability with lower fuel consumption for turbofan and for turboshaft engines. ***FY 2014 Accomplishments:*** Completed preliminary design of engine core technologies for application to adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Initiated long lead hardware procurement and manufacturing of components for experimental engine core demonstration. ***FY 2015 Plans:*** Complete detailed design of engine core technologies for application to adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Initiate hardware procurement and manufacturing of components	19.419	5.633	15.135

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
for transition to experimental engine core demonstration. Initiate instrumentation and assembly of hardware 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.			
Accomplishments/Planned Programs Subtotals	31.649	9.061	24.356

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.