Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*					R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	115.725	151.152	149.321	-	149.321	141.759	151.529	124.519	123.874	Continuing	Continuing
632480: *Aerospace Fuels*	-	6.589	3.581	2.452	-	2.452	4.550	4.573	4.560	4.642	Continuing	Continuing
633035: *Aerospace Power Technology*	-	5.594	3.067	7.520	-	7.520	8.753	7.002	8.825	8.985	Continuing	Continuing
634921: *Aircraft Propulsion Subsystems Int*	-	17.240	77.716	64.176	-	64.176	47.209	58.399	39.617	37.448	Continuing	Continuing
634922: *Space & Missile Rocket Propulsion*	-	26.761	22.446	24.061	-	24.061	24.388	27.598	26.631	27.110	Continuing	Continuing
635098: *Advanced Aerospace Propulsion*	-	28.416	9.553	18.811	-	18.811	42.427	39.140	29.523	30.054	Continuing	Continuing
63681B: *Advanced Turbine Engine Gas Generator*	-	31.125	34.789	32.301	-	32.301	14.432	14.817	15.363	15.635	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to achieve enabling and revolutionary advances in turbine, advanced cycle, and rocket 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 Aerospace 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, since it enables and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	120.924	151.152	153.221	-	153.221
Current President's Budget	115.725	151.152	149.321	-	149.321
Total Adjustments	-5.199	0.000	-3.900	-	-3.900
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	-1.999	0.000			
• SBIR/STTR Transfer	-3.200	0.000			
• Other Adjustments	0.000	0.000	-3.900	-	-3.900

Change Summary Explanation

Decrease in FY 2014 is due to higher DoD priorities.

Reprogrammed for specific projects in accordance with Section 219 of the Duncan Hunter National Defense Authorization Act for Fiscal Year (FY) 2009, as amended by Section 2801 of the National Defense Authorization Act for FY 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 632480: *Aerospace Fuels*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
632480: *Aerospace Fuels*	-	6.589	3.581	2.452	-	2.452	4.550	4.573	4.560	4.642	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project evaluates and demonstrates improved hydrocarbon fuels, unique/alternate fuels and advanced, novel aerospace propulsion technologies for Air Force applications, including high-speed/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 2012	FY 2013	FY 2014
Title: Fuel-Related Thermal Management	1.000	0.500	0.341
Description: Demonstrate thermally stable fuels and fuel system hardware concepts to enhance cooling capacity (performance), minimize fuel coking, and reduce fuel system maintenance.			
FY 2012 Accomplishments: Demonstrated advanced fuel-based turbine engine cooling approaches.			
FY 2013 Plans: Evaluate fuel-related thermal management requirements of variable-cycle engines.			
FY 2014 Plans: Demonstrate fuel-cooled thermal management approaches for variable-cycle engines.			
Title: Gas Turbine Emissions	1.000	0.500	0.341
Description: Develop and demonstrate efficacy of low-cost, environmentally friendly fuel approaches to assess and reduce soot/ particulate emissions from gas turbine engines.			
FY 2012 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 632480: *Aerospace Fuels*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Demonstrated state-of-the-art soot/particulate diagnostics in full scale engine testing. ***FY 2013 Plans:*** Support development of international standard for soot (particulate) emissions from gas turbine engines. ***FY 2014 Plans:*** Demonstrate 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.			
Title: Fuel System Technologies ***Description:*** Develop and demonstrate enhancements to fuel system technology. ***FY 2012 Accomplishments:*** Demonstrated effective structural cooling of second generation endothermic fuels for hypersonic vehicles. ***FY 2013 Plans:*** Demonstrate effectiveness of JP-7 replacement endothermic fuel in reduced-scale cooling simulations to support medium-scale scramjet testing. ***FY 2014 Plans:*** Demonstrate effectiveness of enhanced endothermic fuel under higher heat sink conditions in reduced scale cooling simulations.	1.000	0.500	0.341
Title: Fuel Logistics ***Description:*** Identify, develop, and demonstrate low-cost approaches to reducing the fuel logistics footprint for the Air Force. ***FY 2012 Accomplishments:*** Evaluated fuel compositional relationship to biological growth. ***FY 2013 Plans:*** Demonstrate mitigation of biological growth in alternative fuels and commercial jet fuels in base-level fuel distribution systems. Evaluate effect of trace biodiesel contamination, resulting from transport via pipeline, on fuel properties and stability. ***FY 2014 Plans:*** Evaluate impact of commercial aviation jet fuel conversion (including alternative fuels) on Air Force fuel infrastructure.	0.770	0.800	0.545
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.	2.819	1.281	0.884

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 632480: *Aerospace Fuels*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Demonstrated improved alternative fuel combustion evaluation process to enable more rapid certification. Evaluated fully-synthetic biofuels in "fit-for-purpose" and rig testing to demonstrate durability. ***FY 2013 Plans:*** Evaluate "fit-for-purpose" properties of cellulosic-based alternative aviation fuels produced through thermo-catalytic processes. Initiate support to interagency combustor operability testing. Begin publishing research reports for industry review to faciliate development of consistent and common military and commercial fuel specifications. ***FY 2014 Plans:*** Evaluate "fit-for-purpose" properties of cellulosic-based alternative aviation fuels produced through fermentation processes. Continue to support interagency combustor operability testing. Continue to publish research reports for industry review to faciliate development of consistent and common military and commercial fuel specifications.			
Accomplishments/Planned Programs Subtotals	6.589	3.581	2.452

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 633035: *Aerospace Power Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
633035: *Aerospace Power Technology*	-	5.594	3.067	7.520	-	7.520	8.753	7.002	8.825	8.985	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops and demonstrates electrical power, thermal management, and distribution for aerospace applications. This technology enhances reliability and survivability, and reduces vulnerability, weight, and life cycle costs for manned and remotely piloted aircraft. The electrical power system components developed are projected to provide a two- 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. This project also develops and demonstrates electrical power and thermal management technologies to enable solid state high power density sources for directed energy weapons.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Supporting Subsystem Directed Energy Weapon Technologies	0.200	0.000	0.000
Description: Develop electrical power and thermal management component subsystem technologies to integrate with and deliver high power for operation of directed energy weapons.			
FY 2012 Accomplishments: Supported integration of power and thermal management subsystems for flight demonstration of a high energy laser.			
FY 2013 Plans: Efforts in this area terminated due to higher DoD priorities.			
FY 2014 Plans: N/A			
Title: High Power Aircraft Subsystem Technologies	4.903	3.067	7.520
Description: Develop power generation/conditioning/distribution component, energy storage, and thermal management components and subsystem technologies for integration into high power aircraft.			
FY 2012 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 633035: *Aerospace Power Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Demonstrated robust, high power, high temperature power and thermal management subsystems as part of hardware in the loop validation and verification of system level, energy-optimized, air platform models. ***FY 2013 Plans:*** Demonstrate adaptive power and thermal management subsystems for next generation air platforms with potential transition to fifth generation strike aircraft via system level energy optimized air platform models. ***FY 2014 Plans:*** Complete demonstration of adapative power and thermal management subsystems for next generation air platforms and initiate integration of power and thermal management subsystems for platform level hardware-in-the-loop energy optimization demonstration. Facilitate technology and hardware integration for demonstration.			
Title: Small Remotely Piloted Aircraft Technologies ***Description:*** Develop hybrid electrical power and thermal management components and subsystem technologies for special purpose applications, enabling long endurance of small remotely piloted aircraft. ***FY 2012 Accomplishments:*** Demonstrated ruggedized high endurance small RPA hybrid power and thermal management subsystems. ***FY 2013 Plans:*** Efforts in this area terminated due to higher DoD priorities. ***FY 2014 Plans:*** N/A	0.491	0.000	0.000
Accomplishments/Planned Programs Subtotals	5.594	3.067	7.520

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 634921: *Aircraft Propulsion Subsystems Int*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
634921: *Aircraft Propulsion Subsystems Int*	-	17.240	77.716	64.176	-	64.176	47.209	58.399	39.617	37.448	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 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/airframe compatibility, and power and thermal management subsystems technologies. 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 10 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 2012	FY 2013	FY 2014
Title: Turbofan/Turbojet Durability	1.800	0.500	0.960
Description: Design, fabricate, and demonstrate durability and integration technologies for turbofan/turbojet engines to improve durability, supportability, and affordability of Air Force aircraft.			
FY 2012 Accomplishments: Developed controls and accessories, health monitoring technologies, and light weight external components. Continued to assess and validate repair techniques.			
FY 2013 Plans: Investigate inlet and exhaust interactions.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 634921: *Aircraft Propulsion Subsystems Int*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to investigate inlet and exhaust interactions, active controls and accessories, and health monitoring technologies.			
Title: Turbofan/Turbojet Performance ***Description:*** Design, fabricate, and test advanced component technologies for improved performance and fuel consumption of turbofan/turbojet engines. ***FY 2012 Accomplishments:*** Completed manufacturing advanced adaptive cycle (third air stream) engine components, including an advanced fan, high work variable low turbine for long dwell time, controls, inlet integration, and advanced exhaust nozzle for subsonic to sustained supersonic flight. Conducted experimental testing of engine technologies. Continued preliminary design of high bypass/high overall pressure ratio engine technologies for improved fuel consumption. ***FY 2013 Plans:*** Finish assembly and instrumentation of advanced adaptive cycle (third air stream) engine technologies, including an advanced fan, high work variable low turbine for long dwell time, controls, inlet integration, and advanced exhaust nozzle for subsonic to sustained supersonic flight. Complete experimental testing of engine technologies. ***FY 2014 Plans:*** N/A	14.240	9.167	0.000
Title: Missile/Remotely Piloted Aircraft Engine Performance ***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 2012 Accomplishments:*** Completed detailed design and initiated fabrication of components of a higher specific thrust, low-cost expendable turbine engine for improved fuel efficiency to significantly improve range. Continued detailed design of fan, low spool turbine spool, and other engine components for advanced, fuel efficient subsonic unmanned turbofan engines. ***FY 2013 Plans:*** Complete assembly and instrumentation of supersonic, long endurance turbine engine components. Complete critical technology rig testing and begin sea level testing of supersonic, long endurance turbine engines. Increase in FY 2013 accelerates these engine components to support potential acquisition decision and need date. ***FY 2014 Plans:*** Complete ground testing of demonstration supersonic, long endurance turbine engines at simulated altitude conditions. Accelerate engine activity to meet follow on need date. Continue rig testing of advanced components for subsonic unmanned/	1.200	15.916	18.444

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 634921: *Aircraft Propulsion Subsystems Int*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
missile engine technology. Complete detailed design of subsonic small turbine engine technology. Begin preliminary design of subsonic mid sized turbine engine technology for remotely piloted aircraft. Increase in FY 2014 to ensure completion of rig testing and detailed design to support potential acquisition decision and need date.			
Title: Adaptive Turbine Engine Technologies ***Description:*** Design, fabricate, and demonstrate performance, durability, and operability technologies to mature adaptive turbine engine technologies. ***FY 2012 Accomplishments:*** N/A ***FY 2013 Plans:*** Initiate preliminary designs for an adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Accelerate engine technology development activity to meet follow on activity need date. Perform augmentor/ exhaust nozzle cold flow testing. Perform preliminary design of an advanced adaptive fan. Initiate long lead hardware procurement. ***FY 2014 Plans:*** Complete prelimary designs for an adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Initiate manufacturing of advanced adaptive fan and augmentor/exhaust rig test hardware. Accelerate engine technology development activity to meet to support transition for follow on activities.	0.000	52.133	44.772
Accomplishments/Planned Programs Subtotals	17.240	77.716	64.176

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 634922: *Space & Missile Rocket Propulsion*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
634922: *Space & Missile Rocket Propulsion*	-	26.761	22.446	24.061	-	24.061	24.388	27.598	26.631	27.110	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 boost/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 20-50 percent and reduce launch, operations, and support costs by approximately 30 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 50 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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Liquid Rocket Propulsion Technologies	20.751	19.680	20.204
Description: Develop liquid rocket propulsion technology for current and future space launch vehicles. ***FY 2012 Accomplishments:*** Completed the validation and verification of modeling and simulation tools developed for advanced cryogenic upper stage technologies. Continued development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept for future reusable launch vehicles. Continued subscale preburner and turbine component testing to demonstrate hydrocarbon boost technologies. Continued oxygen-rich material manufacturing scale-up effort to support hydrocarbon boost demonstration program. Conducted component scale-up and characterization for advanced hydrocarbon engine technologies using fuels other than kerosene. ***FY 2013 Plans:*** Continue development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept for future reusable launch vehicles. Continue sub-scale preburner and turbine component testing to demonstrate			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 634922: *Space & Missile Rocket Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
hydrocarbon boost technologies. Complete oxygen-rich material manufacturing scale-up effort to support hydrocarbon boost demonstration program. ***FY 2014 Plans:*** Continue development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept for future reusable and expendable launch vehicles. Complete sub-scale preburner and continue sub-scale turbine component testing to demonstrate hydrocarbon boost technologies. Conduct thrust chamber sub-scale development. Begin full-scale pre-burner component development.			
Title: On-Orbit Propulsion Technologies ***Description:*** Develop solar electric, electric, and monopropellant propulsion technologies for existing and future satellites, upper stages, orbit transfer vehicles, and satellite maneuvering. ***FY 2012 Accomplishments:*** Conducted scale-up of propulsion technologies for spacecraft with the need for high mobility on orbit. Completed hardware scale-up and conducted testing of hardware for an advanced multi-mode (high thrust or high efficiency) propulsion system for satellites. Built components for integration and demonstration of next generation of chemical thrusters for spacecraft propulsion systems. ***FY 2013 Plans:*** Efforts terminated in FY2013 due to higher DoD priorities. Propulsion unit for cubesats transitioned to customer for flight demonstration. High performance AF-M315E mono-propellant (non-toxic replacement for highly toxic Hydrazine) thruster technology transitioned to NASA for flight demo in FY15. ***FY 2014 Plans:*** N/A	3.344	0.000	0.000
Title: Ballistic Missile Technologies ***Description:*** Develop and demonstrate missile propulsion and post-boost control systems technologies for ballistic missiles. ***FY 2012 Accomplishments:*** Completed propellant component development and transition into next generation integrated motor demonstration. ***FY 2013 Plans:*** Develop advanced missile case, insulation, and nozzle technologies. Develop subscale component developments providing sub-scale validation of modeling and simulation tools. ***FY 2014 Plans:***	1.800	1.587	2.145

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 634922: *Space & Missile Rocket Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to develop advanced missile case, insulation, and nozzle technologies. Continue to develop subscale components providing sub-scale validation of modeling and simulation tools. Demonstrate prototype approach to thrust management.			
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 2012 Accomplishments:*** Performed integration and full-scale demonstration of advanced aging and surveillance tools for solid rocket motors to validate and verify modeling and simulation tools and component technologies. ***FY 2013 Plans:*** Continue 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. ***FY 2014 Plans:*** Complete 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. Begin scale-up efforts to demonstrate previous technologies in full-scale applications. Begin development of next generation of sensors used for aging and surveillance.	0.866	1.179	1.712
Accomplishments/Planned Programs Subtotals	26.761	22.446	24.061

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.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 635098: *Advanced Aerospace Propulsion*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635098: *Advanced Aerospace Propulsion*	-	28.416	9.553	18.811	-	18.811	42.427	39.140	29.523	30.054	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 over the range of Mach 0.0 to 7.0. 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 2012	FY 2013	FY 2014
Title: Scramjet Technologies	28.416	9.553	18.811
Description: Develop and demonstrate technologies for a hydrocarbon-fueled scramjet with robust operation over a range of Mach 4.0 to 7.0.			
FY 2012 Accomplishments: Conducted second flight test of a scramjet engine demonstrator. Analyzed second flight test data and conducted additional ground tests on inlet and fuel systems to determine cause of inlet unstart during transition from ethylene to JP-7. Made changes to X-51A in preparation for a third flight. Conducted third flight of X-51A. Post-test investigation determined that vehicle fin actuator unlocked shortly after separation from rocket booster, resulting in loss of vehicle during third flight. Conducted proof of concept test on cold start subsystems.			
FY 2013 Plans: Complete fourth flight test of a scramjet engine demonstrator. Analyze flight test data and complete final report. Continue development and demonstration of tactically compliant subsystems, including scramjet engine start system, fuel system, and engine controls. Complete component demonstration of tactically compliant cold start system. Initiate design of flight weight			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 635098: *Advanced Aerospace Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
scramjet engine cold start system, fuel system components, and advanced engine control system technologies. Decrease in FY13 due to higher DoD priorities. ***FY 2014 Plans:*** Continue development and demonstration of tactically compliant subsystems, including scramjet engine start system, fuel system, and engine controls. Initiate fabrication of flight weight ground test engine to demonstrate tactially compliant cold start system. Design and initiate fabrication of ground test flight weight engine components for High Speed Strike Weapon demonstration.			
Accomplishments/Planned Programs Subtotals	28.416	9.553	18.811

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 63681B: *Advanced Turbine Engine Gas Generator*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
63681B: *Advanced Turbine Engine Gas Generator*	-	31.125	34.789	32.301	-	32.301	14.432	14.817	15.363	15.635	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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, and exhaust systems) and system level technologies (such as integrated power generators and thermal management systems) on core engine performance and durability in "core-centric engine" demonstration. The core performances of this project are validated on demonstrator engines in the Aerospace Propulsion Subsystems Integration Project of this Program Element. 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 2012	FY 2013	FY 2014
Title: Core Engine Technologies	17.927	15.322	11.030
Description: Design, fabricate, and demonstrate performance predictions in core engines, using innovative engine cycles and advanced materials for turbofan/turbojet engines.			
FY 2012 Accomplishments: Completed hardware fabrication, assembly and experimental demonstration of high temperature capable, durable compressor, combustor, and turbine technologies for adaptive core engines. Continued fabrication of component technologies and initiate assembly for a core-centric durability engine demonstration. Continued fabrication of component technologies for increased reliability, maintainability, and affordability for potential transition to fielded systems. Conducted detailed design of system-level technologies and weapon systems integration on core engine performance.			
FY 2013 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 63681B: *Advanced Turbine Engine Gas Generator*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Evaluate and conduct post demonstration assessment of high temperature capable, durable compressor, combustor, and turbine technologies for adaptive core engines. Complete fabrication of component technologies and assembly for a core-centric durability engine demonstration. Continue fabrication of component technologies for increased reliability, maintainability, and affordability for potential transition to fielded systems. ***FY 2014 Plans:*** Complete assembly and test of a core-centric durability engine technology demonstration. Complete fabrication of component technologies for increased reliability, maintainability, and affordability for potential transition to fielded systems. Initiate durability testing of component technologies.			
Title: High Pressure Ratio Core Engine Technologies ***Description:*** Design, fabricate, and demonstrate high overall pressure ratio cores to provide increased durability and affordability with lower fuel consumption for turbofan/turboshaft engines. ***FY 2012 Accomplishments:*** Continue selective risk reduction experimental demonstrations of small versatile affordable advanced core engine technologies for remotely piloted aircraft. Continue fabrication of efficient small engine component technologies including high efficiency, high pressure ratio, high temperature capability compressor, high heat release combustor, and high cooling effectiveness or uncooled turbine for use in both manned and umanned remotely piloted aircraft applications. Initiated conceptual design for advanced very efficient and very high pressure ratio core engine. Completed some compressor rig testing. ***FY 2013 Plans:*** Begin preliminary design of small efficient core engine concept with advanced technologies including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling effectiveness turbine with an integrated thermal management system and advanced mechanical systems. Decrease from FY 2012 to FY 2013 due to higher DoD priorities. ***FY 2014 Plans:*** Begin detailed design of small efficient core engine 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.	13.198	3.500	1.200
Title: Adaptive Turbine Engine Core Technologies ***Description:*** Design, fabricate, and demonstrate performance, durability, and operability technologies to mature adaptive turbine engine core technologies.	0.000	15.967	20.071

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 63681B: *Advanced Turbine Engine Gas Generator*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: N/A ***FY 2013 Plans:*** Conduct design of core technologies for application to adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Perform power and thermal management system analysis and assessment. ***FY 2014 Plans:*** Complete preliminary design of core technologies for application to adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Initiate long lead hardware procurement and manufacturing of components for experimental core demonstration. Increase in FY 2014 supports execution and completion of preliminary design, purchases of raw materials for components, and contracts second and third tier turbine engine suppliers of components.			
Accomplishments/Planned Programs Subtotals	31.125	34.789	32.301

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.