PE NUMBER: 0602203F
PE TITLE: Aerospace Propulsion

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	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	129.190	155.673	170.885	159.359	167.671	170.348	172.094	Continuing	TBD
3012	Advanced Propulsion Technology	12.140	19.593	25.038	22.601	23.046	23.430	23.795	Continuing	TBD
3048	Fuels and Lubrication	15.577	18.997	17.292	13.029	13.797	13.957	14.079	Continuing	TBD
3066	Turbine Engine Technology	33.769	36.862	33.529	34.433	36.593	37.083	37.517	Continuing	TBD
3145	Aerospace Power Technology	42.993	44.392	30.364	31.667	33.782	34.309	34.804	Continuing	TBD
33SP	Space Rocket Component Tech	0.000	0.000	49.305	46.497	48.774	49.726	49.925	0.000	0.000
4847	Rocket Propulsion Technology	24.711	35.829	15.357	11.132	11.679	11.843	11.974	Continuing	TBD

Note: In FY 2007, Project 33SP, Space Rocket Component Technology will transfer from PE 0602500F, Multi-Disciplinary Space Technology, Project 5026, Rocket Propulsion Component Technology, and Project 5027, High Speed Airbreathing Propulsion Technology, in order to more effectively manage and provide oversight of the efforts. Funds for the FY2006 Congressionally-directed Notre Dame Center for Flow Physics and Control in the amount of $3.0 million are in the process of being moved to PE 0601102F, Defense Research Sciences, from PE 0602203F, Aerospace Propulsion, for execution. Funds for the FY2006 Congressionally-directed Lightweight Photovoltaic Electricity and Hydrogen for Portable, On-Demand Power for Defense Applications in the amount of $1.0 million are in the process of being moved to PE 0602601F, Space Technology, from PE 0602203F, Aerospace Propulsion, for execution.

(U) A. Mission Description and Budget Item Justification

This program develops propulsion and power technologies to achieve enabling and revolutionary aerospace technology capabilities. The program has five projects, each focusing on a technology area critical to the Air Force. The Advanced Propulsion Technology develops high-speed airbreathing propulsion engines to include combined cycle, ramjet, and hypersonic scramjet technologies to enable revolutionary propulsion capability for the Air Force. The Fuels and Lubrication project develops new fuels, lubricants, and combustion concepts and technologies for new and existing engines and directly supports the Integrated High Performance Turbine Engine Technology (IHPTET) and the Versatile Affordable Advanced Turbine Engine (VAATE) programs. The Turbine Engine Technology project develops enabling capabilities to enhance performance and affordability of existing weapon systems to include efforts that are part of the IHPTET and VAATE programs. The Aerospace Power project develops efficient energy conversion/storage, power generation/power conditioning/distribution, and thermal management techniques for ground, air, and space military applications. Finally, the Rocket Propulsion Technology project pursues advances in rocket technologies for space access, space maneuver, and tactical and strategic missiles to include efforts that are part of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) and Technology for the Sustainment Systems (TSSS) programs. Note: In FY 2006, Congress added $4.3 million for Advanced Vehicle and Propulsion Center (AVPC), $1.0 million for Aerospace Lab Equipment Upgrade, $1.8 million for Affordable Lightweight Power Supply Development, $1.0 million for Cell-Level Battery Control, $1.4 million for Center for Security of Large-Scale Systems, $1.3 million for High Flux ESC System with TES for Military High Energy Laser, $1.0 million for High Regression Rate Hybrid Rocket Fuels, $1.0 million for Information Assurance Initiative, $5.3 million for Integrated Power and Aircraft Technologies (INPACT), $0.5 million for Intelligent Engine Software Development for Advanced Turbine Engines, $18.0 million for Jet and Rocket Engine Test Set (JRETS), $1.0 million for Lightweight Photovoltaic Electricity and Hydrogen for Portable, On -Demand Power for Defense Applications, $1.4 million for MEPS Thermal Management, $3.0 million for Notre Dame Center for Flow Physics and Control, $1.7 million for Portable Power Solution Employing Chemical Hydrides, $2.5 million for Pulse Detonation Engine,

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$1.4 million for Ultrafast, Ultraintense Laser Micro Fabrication and Diagnostics, $1.8 million for VAATE (Versatile Affordable Advanced Turbine Engine) - TMC Flade Technology Demonstration, and $1.0 million for Wavelength Agile Spectral Harmonic Sensor. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	132.918	107.523	115.360
(U)	Current PBR/President's Budget	129.190	155.673	170.885
(U)	Total Adjustments	-3.728	48.150	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.101	-2.250	
	Congressional Increases		50.400	
	Reprogrammings	-1.498		
	SBIR/STTR Transfer	-2.129		

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, RDT&E Project Justification

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BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT NUMBER AND TITLE: 3012 Advanced Propulsion Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3012 Advanced Propulsion Technology	12.140	19.593	25.038	22.601	23.046	23.430	23.795	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2005, funding level was reduced as Air Force efforts shifted from variable-geometry demonstrators to Advanced Technology Development (6.3) fixed-geometry demonstrators. In FY 2006 and 2007, funding was increased to accelerate efforts to develop technologies to support an Air Force scramjet effort.

(U) A. Mission Description and Budget Item Justification

This project develops combined/advanced cycle airbreathing high-speed (up to Mach 4) and hypersonic (Mach 4 to 8+) propulsion technologies to provide revolutionary propulsion options for the Air Force. These new engine technologies will enable future high-speed/hypersonic weapons and aircraft concepts. The primary focus is on hydrocarbon-fueled engines capable of operating over a broad range of flight Mach numbers. Technologies developed under this program enable capabilities of interest to both Department of Defense and NASA. Efforts include modeling, simulations, and proof of concept demonstrations of critical components; advanced component development; and ground-based demonstrations.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop advanced fuel-cooled scramjet engine technologies to support flight demonstration and enable the broad application of hypersonics to meet future warfighter needs.	6.804	7.702	12.204

(U) In FY 2005: Demonstrated flight-weight control valves in full-scale combustion tests. Demonstrated engine control inputs and preliminary control algorithms based on sensing shock location and stability. Performed detailed analysis mating of scramjet flight engines to demonstrator vehicles. Furthered the trajectory optimization for flight test. Completed evaluation of gas generator as engine start technique. Performed initial evaluation of barbotage fuel injection as scramjet starting aid. Performed initial verification of engine control techniques, based on rapid shock train identification/characterization coupled with fuel control logic, to ensure stable scramjet operation. Completed fabrication of a flight weight, fuel-cooled ground test engine with a variable geometry inlet.

(U) In FY 2006: Continue development and demonstration of flight weight engine components and a control system with closed loop controller. Continue performing trajectory optimization for flight test. Continue evaluating options for scramjet start, including gas generator/heat exchanger system, barbotage fuel injection, plasma ignition, and silane injection with a mechanical throat or air throttle. Continue verification of operation of engine control techniques, based on rapid shock train identification/ characterization coupled with fuel control logic, to ensure stable scramjet operation. Design, fabricate, and initiate ground test of a flight weight, fixed geometry inlet scramjet engine with improved operability to reduce flight test risk.

(U) In FY 2007: Continue development and demonstration of flight weight engine components and a control system with closed loop controller. Continue performing trajectory optimization for flight test. Continue evaluating options for scramjet start, including gas generator/heat exchanger system, barbotage fuel injection, plasma ignition, and

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	silane injection with a mechanical throat or air throttle. Continue verification of operation of engine control techniques, based on rapid shock train identification/ characterization coupled with fuel control logic, to ensure stable scramjet operation. Complete ground test of a flight weight, fixed geometry inlet scramjet engine with improved operability to reduce flight test risk.			
(U)				
(U)	MAJOR THRUST: Conduct assessments, system design trades, and simulations to integrate combined cycle engines (CCEs) and advanced cycle airbreathing hypersonic propulsion technologies into future missiles and into manned and unmanned air and space vehicle concepts. CCEs require the development and demonstration of components to integrate scramjets with high speed turbines and/or rocket engines for efficient propulsion over a broad range of Mach numbers.	0.234	1.079	2.239
(U)	In FY 2005: Performed system trade studies to determine military payoff and establish component technology goals. Established initial component and engine performance objectives to enable development of affordable hypersonic flight demonstrators including potential efforts jointly with NASA and DARPA.			
(U)	In FY 2006: Continue system trade studies to determine military payoff and establish component technology goals. Continue defining component and engine performance objectives to enable development of affordable hypersonic flight demonstrators jointly with NASA and DARPA. Initiate development of advanced components for turbine-based and rocket-based CCEs. Initial emphasis is on advanced inlets for turbine-based CCEs capable of operating for Mach 0-8. Design sub-scale inlet test article.			
(U)	In FY 2007: Continue system trade studies to determine military payoff and establish component technology goals. Continue defining component and engine performance objectives to enable development of affordable hypersonic flight demonstrators jointly with NASA and DARPA. Continue development of advanced components for turbine-based and rocket-based CCEs. Fabricate and initiate test of advanced inlets for turbine-based CCEs capable of operating for Mach 0-Mach 8.			
(U)				
(U)	MAJOR THRUST: Develop robust hydrocarbon fueled scramjet engine components and technologies to improve performance, operability, durability, and scalability for future missiles and for aerospace vehicles.	4.128	9.826	10.595
(U)	In FY 2005: Assessed scaling and structural efficiency for rectangular, circular, and elliptical scramjets for the development of advanced engine components to improve scramjet operating margin and to establish scramjet scaling laws for reusable applications. Conducted analysis of advanced inlets and isolators while developing techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Supported development of low internal drag flame stabilization devices and flight test engine components.			
(U)	In FY 2006: Continue development of advanced engine components to improve scramjet operating margin and to			

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(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	establish scramjet scaling laws for reusable applications. Continue development of variable geometry techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Fabricate and initiate test of scramjet combustors sized for reusable applications with improved structural efficiency. Support development of low internal drag flame stabilization devices and flight test engine components.			
(U)	In FY 2007: Continue development of advanced engine components to improve scramjet operating margin and to establish scramjet scaling laws for reusable applications. Continue development of variable geometry techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Complete test of scramjet combustors sized for reusable applications with improved structural efficiency. Initiate development of improved durability engine concepts. Continue development of low internal drag flame stabilization devices and flight test engine components.			
(U)				
(U)	CONGRESSIONAL ADD: Information Assurance Initiative.	0.974	0.986	0.000
(U)	In FY 2005: Provide enhanced security and emergency response to physical threats/attacks and natural disasters.			
(U)	In FY 2006: Support technology infrastructure security with upgrades in electronic security of doors, security of video teleconferencing systems and for a central public address systems and separate research and development network.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	12.140	19.593	25.038

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0601102F, Defense Research Sciences.									
(U) PE 0602201F, Aerospace Flight Dynamics.									
(U) PE 0602500F, Multi-Disciplinary Space Tech.									
(U) PE 0602602F, Conventional Munitions.									
(U) PE 0602702E, Tactical									

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

Technology.

(U) PE 0603211F, Aerospace Structures.

(U) PE 0603216F, Aerospace Propulsion and Power Technology.

(U) PE 0603601F, Conventional Weapons Technology.

(U) Program is reported to/coordinated by the Joint Army/Navy/NASA/Air Force (JANNAF) Executive Committee.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT NUMBER AND TITLE: 3048 Fuels and Lubrication

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3048 Fuels and Lubrication	15.577	18.997	17.292	13.029	13.797	13.957	14.079	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops improved fuels, lubricants, mechanical systems, and combustion concepts for advanced turbine engines, scramjets, pulse detonation, and combined cycle engines, and technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. Systems applications include missiles, aircraft, sustained high-speed vehicles, and responsive space launch. Analytical and experimental areas of emphasis include fuels and fuels logistics, lubricants, bearings, electromagnetic rotor, oil-less engine technology, optical diagnostics, fundamental combustion, and detonations. Fuels and lubricants for these engines must be thermally stable, cost-effective, and operate over a broad range of conditions. Advanced combustion concepts must be cost-effective, durable, and reduce pollutant emissions.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop low-cost additive and fuel system approaches to improve fuel properties and to expand the flight envelope for manned and unmanned aircraft.	1.540	1.780	2.172
(U) In FY 2005: Completed additive package optimization and test protocols to enable JP-8 to achieve the performance of JPTS (jet propellant thermally stable). Conducted lab-scale evaluation of approaches to increase JP-8 temperature capability to 900 degrees Fahrenheit, including thermal stability additives, fuel deoxygenation, and improved materials and coatings. Further enhanced existing fuel modeling and simulation capabilities by incorporating more realistic additive performance models. Developed engine thermal management models.			
(U) In FY 2006: Continue conducting lab-scale evaluation of approaches to increase JP-8 temperature capability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced alternative energy fuels, and improved materials and coatings. Complete initial development of engine thermal management models, aiming toward system-level models of advanced aircraft. Initiate development of laboratory-scale combustion tests for evaluating combustion performance of fuels and additives at low fuel and air temperatures.			
(U) In FY 2007: Continue conducting lab-scale evaluation of approaches to increase JP-8 temperature capability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced alternative energy fuels, and improved materials and coatings. Initiate effort to validate component performance models on aircraft thermal management simulator. Continue to develop approaches to assess and improve additive combustion behavior at low fuel and air temperatures. Test fuel candidates in bench scale rigs simulating advanced high Mach propulsion systems.			
(U)			
(U) MAJOR THRUST: Develop advanced additive approaches to reduce engine emissions and signature (including nano-scale additives), as well as advanced emission diagnostic test protocols.	0.955	1.103	1.347

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2005: Completed development and application of advanced diagnostics for sub-micron particulate emissions for the assessing additives performance in laboratory scale combustion tests.			
(U)	In FY 2006: Continue assessing novel fuel additives including nano-technologies and fuels derived from alternative energy resources to reduce emissions in laboratory scale combustion rigs. Develop higher-pressure laboratory-scale combustion tests and diagnostics for sub-micron particulate investigations.			
(U)	In FY 2007: Complete assessing novel fuel additives including nano-technologies and fuels derived from alternative energy resources to reduce emissions in laboratory scale combustion rigs. Initiate higher-pressure measurements of additive and fuel effects on sub-micron particulate generation during combustion.			
(U)				
(U)	MAJOR THRUST: Study and evaluate low-cost approaches to reduce fuel logistics footprint to simplify logistics and reduce cost (including field and on-board additive injections and improvements to existing fuel additive packages), as well as study fuel logistics vulnerabilities and develop detection and mitigation technologies.	0.955	1.103	1.347
(U)	In FY 2005: Developed improvements to existing fuel additive packages to simplify logistics and reduce cost. Completed extensive thermal stability, low temperature viscosity, and emissions testing of one Fischer-Tropsch (F-T) fuel and initiated testing of F-T/JP-8 fuel blends. Further investigated biological contamination in fuels and the impact of fuel logistic supply chains. Performed initial development of field mitigation techniques for biological fuel contamination. Demonstrated use of DNA sequencing and Polymerase Chain Reaction (PCR) to identify many organisms in field jet fuel samples not found using current techniques in the development of new field fuel quality diagnostics for fuel properties and bio-contamination.			
(U)	In FY 2006: Complete assessment of fuel additives optimization for logistics footprint reduction. Continue to investigate performance of F-T and other alternative fuels for aircraft and other field hardware. Complete investigation of supply chain biological contamination and the impact on fuel logistics. Initiate evaluation of nano-technology fuel sensors and biological mitigation techniques. Complete development of advanced field diagnostics techniques for fuel properties and bio-contamination.			
(U)	In FY 2007: Continue to investigate performance of F-T and other alternative fuels for aircraft and other field hardware. Continue evaluation of advanced nano-technology fuel sensors, nano-technology fuel additives, and novel detection and mitigation technologies for biological growth.			
(U)				
(U)	MAJOR THRUST: Investigate hydrocarbon and other high energy density fuels for advanced and combined cycle engines for high-speed aerospace vehicles and low-cost boost applications.	0.477	0.552	0.673
(U)	In FY 2005: Developed fuel property and performance database for industry and Government use in selecting alternative hydrocarbon fuels for boost applications. Tested approaches to assess fuel thermal stability under high			

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	heat flux conditions relevant to advanced rockets and combined cycle engines.			
(U)	In FY 2006: Continue to assess advanced hydrocarbon propellant stability under high heat flux conditions for advanced rockets and combined cycle engines.			
(U)	In FY 2007: Continue to assess advanced hydrocarbon propellant stability under high heat flux conditions. Collect improved fuel property data for hydrocarbon propellant database.			
(U)				
(U)	MAJOR THRUST: Develop, test, and evaluate revolutionary combustor and propulsion concepts for gas turbine, pulsed detonation, and combined cycle engines for missiles, manned and unmanned systems, and reuseable access to space; perform payoff analyses and configuration trade studies for these systems; and evaluate the combustion and emissions characteristics of fuels and fuel additives.	3.328	3.845	4.691
(U)	In FY 2005: Evaluated compact, high performance combustion systems at realistic operating conditions. Investigated larger-scale, inter-turbine burner combustor concepts at realistic operating conditions. Evaluated combined cycle pulsed detonation engine (PDE) concepts. Addressed the operational issues associated with incorporating PDE propulsion technologies into gas turbine engines. Conducted experiments to extend the operability limits of pure PDE for application to high-speed missiles. Evaluated fundamental combustion issues associated with combustors fed by high-temperature fuel systems like those required for supersonic cruise aircraft.			
(U)	In FY 2006: Begin evaluating advanced combustion system performance at realistic operating conditions. Start investigating larger-scale inter-turbine burner concepts at relevant engine operating conditions to increase mission flexibility. Continue developing a PDE into turbine-based hybrid concept. Conduct experiments to validate chemical kinetics of practical fuels at high pressure and temperature. Perform modeling and simulation of advanced combustion systems to decrease design cycle time, optimize compact combustor, and augmentor designs, and to understand physical parameters controlling combustion processes. Evaluate and develop novel lightweight, high performance augmentor concepts.			
(U)	In FY 2007: Continue evaluating advanced combustion system performance at realistic operating conditions. Continue investigating inter-turbine burning concepts for large gas turbine engines. Continue integration of PDE into turbine-based hybrid concept. Evaluate and optimize advanced combustor, augmentor, and PDE concepts using modeling and simulation tools.			
(U)				
(U)	MAJOR THRUST: Develop approaches to extend the life of endothermic fuels and fuel system components for sustained supersonic and reusable hypersonic cruise applications.	0.477	0.552	0.676
(U)	In FY 2005: Evaluated, at a laboratory scale, approaches to improve fuel heat sink capability. Tested systems to minimize regenerative cooling heat loads absorbed by endothermic fuel systems. Tested means to improve fuel			

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	combustion performance, especially during cold start and cycle transition. Demonstrated combustion and heat sink performance of alternatives to baseline JP-7 fuel to improve fuel system modeling and simulation tools to better simulate endothermic fuel behavior.			
(U)	In FY 2006: Continue evaluating, at a laboratory scale, approaches to improve fuel heat sink and provide thermal management capability for high speed systems. Evaluate surface/catalyst effects on coke reduction to improve fuel heat sink capability and increase fuel system life. Initiate assessment of unconventional approaches to increase fuel heat sink, such as steam reforming.			
(U)	In FY 2007: Continue development of improved surfaces/catalysts to mitigate coking and thus improve fuel heat sink capability. Continue assessment of unconventional approaches to increase fuel heat sink and minimize regenerative cooling heat loads, including low heat rejection structures.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for application to revolutionary propulsion technologies.	0.600	0.692	0.845
(U)	In FY 2005: Completed developing and testing sensors for the control of combustor performance and extension of component life. Developed diagnostic tools to evaluate the combustion issues related to engines burning high-temperature fuels. Performed initial investigation of the interaction of high-intensity laser light with matter for micromachining and diagnostic capabilities.			
(U)	In FY 2006: Begin applying advanced laser diagnostics for accurate measurements inside advanced gas turbine combustion systems that will improve design cycle time. Develop sensor technologies for use in intelligent gas turbine engine combustion systems for enhanced operability, increased durability and performance. Continue investigation of high intensity laser light with matter for micromachining and diagnostic capabilities.			
(U)	In FY 2007: Continue application of advanced diagnostics in a relevant gas turbine combustion system environment. Apply diagnostics to sensor development and validate sensors in relevant gas turbine engine system. Conduct experiments to obtain benchmark-quality data for improvement of combustion modeling and simulation tools.			
(U)				
(U)	MAJOR THRUST: Develop, test, and qualify advanced turbine engine lubricants for the Air Force and DoD. Establish target requirements and transition opportunities for new oils by working with DoD agencies, industry, and users. Generate and maintain military specifications for aviation engine lubricants, as well as continued field support activities for aviation lubrication technologies and DoD operational units.	1.853	2.140	2.612
(U)	In FY 2005: Expanded development and testing of advanced bearing and lubrication system concepts, components, and materials for improved engine performance, affordability, and engine health monitoring. Designed test approaches for optimal ester lubricant to military and commercial turbine engines. Coordinated oil research and			

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	development activities between Government, engine manufacturers, and oil companies in support of the Joint Oil Program (JOP). Engaged oil companies to deliver prototype lubricants and initiated bench top evaluation. Designed test approaches for JOP lubricants for use in new fighter demonstration engines.			
(U)	In FY 2006: Continue development and testing of advanced bearing and lubrication system concepts, components, and materials for improved engine performance, affordability, and engine health monitoring. Continue testing to focus and develop lubricants and mechanical systems for man-rated, expendable, and Unmanned Aerial Vehicle (UAV) turbine engines. Design test approaches for enhanced high thermal stability (HTS) oils for new, legacy, and commercial turbine engines. Focus optimal ester lubricant development on high Mach/high temperature military and commercial turbine engines. Test prototype JOP lubricants with mechanical hardware in preparation of new fighter demonstration engines.			
(U)	In FY 2007: Begin technology insertion of advanced bearing and lubrication system concepts, components, and materials for improved engine performance, affordability, and engine health monitoring into demonstrator cores and engines. Continue testing to focus and develop lubricants and mechanical systems for man-rated, expendable, and UAV turbine engines. Continue optimal ester lubricant development for high Mach/high temperature military and commercial turbine engines. Coordinate and support demonstration of JOP lubricants in new fighter asset engines. Deliver military specifications and test methods for DoD lubricants to support new fighter engines.			
(U)				
(U)	MAJOR THRUST: Develop and test advanced bearing material technology and bearing concepts for small, intermediate, and large-sized turbine engine applications.	2.077	2.400	2.929
(U)	In FY 2005: Conducted fatigue life screening tests of advanced bearing materials on 40mm size bearings in support of large turbofan engines. Modified an existing test rig to investigate foil bearing load capacity and rotor dynamic stiffness and damping coefficients under dynamic load conditions for a high Mach engine application, specifically ultra-high temperature lubrication concepts and composite bearing cages for supersonic missile engines and bearing heat generation studies for large engines. Conducted modeling and simulation activities to advance design, shorten development time, and reduce test requirements for mechanical and electromagnetic rotor support and power generation systems. Supported industry development of hybrid (metal/ceramic) bearing designs for new fighter engines.			
(U)	In FY 2006: Continue conducting airfoil shaft bearing testing in large shaft diameter sizes to determine load capacity and rotor size limitations of this technology. Continue development and test of affordable rotor support technology for small-, intermediate-, and large-sized turbine engine applications. Continue enhancement of modeling and simulation activities to advance design, shorten development time, and reduce test requirements for mechanical and electromagnetic rotor support and power generation systems. Continue modeling airfoil shaft bearings for advanced			

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	engine rotor support and power generation. Begin full-scale tests of hybrid (metal/ceramic) bearing technology for the new fighter demonstrator engines with lubricant from the JOP. Initiate study of mechanical systems thermal management concepts for turbo accelerators in combined cycle engines.			
(U)	In FY 2007: Continue conducting airfoil shaft bearing tests in larger shaft diameter sizes to determine load capacity and rotor size limitations of this technology. Continue development and test of affordable rotor support technology for small-, intermediate-, and large-sized turbine engine applications. Continue enhancement of modeling and simulation activities to advance design, shorten development time, and reduce test requirements for mechanical and electromagnetic rotor support and power generation systems. Improve the modeling of airfoil shaft bearings and initiate evaluation of insertion opportunities for advanced engine rotor support and power generation. Continue transition/transfer of airfoil shaft bearing technology to bearing and engine companies. Demonstrate hybrid (metal/ceramic) bearing and JOP lubricants in the new fighter demonstrator engines. Initiate programs for hardware needed for optimum thermal protection designs for high mach/high temperature turbine engines and accelerators. Expand the previous studies of advanced rotor support and power generation for turbine and combined cycle engines.			
(U)				
(U)	CONGRESSIONAL ADD: Intense, Ultrafast Laser Microfabrication and Diagnostics.	0.975	1.380	0.000
(U)	In FY 2005: Developed the technology base required to reduce the development, production, and maintenance costs of advanced weapon systems through the use of intense, ultrafast lasers.			
(U)	In FY 2006: Develop technology to exploit characteristics of intense, ultrafast lasers for sensors and weapons systems. Investigate these systems for use in gas turbine engine diagnostics. Develop a new generation of extreme light diagnostics that can be used to: analyze and evaluate materials, aid in the development and validation of system design and life prediction models, and perform inspections for fleet maintenance.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Wavelength Agile Spectral Harmonic Oxygen Sensor.	0.975	0.986	0.000
(U)	In FY 2005: Developed a sensor using wavelength agile spectral harmonics to measure oxygen concentration in high-performance fuel tanks, allowing the verification and optimization of nitrogen inerting.			
(U)	In FY 2006: Design, fabricate, and test a second generation oxygen sensor to measure oxygen concentration in high-performance fuel tanks. Conduct environmental testing of the sensor under simulated fuel tank conditions and perform Category A flight testing to aid in modification of the design, resulting in a third generation sensor design. Also conduct an evaluation of second generation sensor specifications and certification plan.			
(U)	In FY 2007: Not Applicable.			
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3048 Fuels and Lubrication

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	CONGRESSIONAL ADD: Hybrid Bearings.	1.365	0.000	0.000
(U)	In FY 2005: Accelerated the development of advanced hybrid bearing technology, which will provide increased thrust load and speed capability, reliability, and a safety margin of aircraft turbine engines.			
(U)	In FY 2006: Develop advanced hybrid bearing technology for use in high performance turbine engines. Conduct bearing fatigue life testing of advanced Pyrowear 675 (P675) hybrid bearings, P675 heat treatment optimization and characterization, develop critical flaw models for Silicon Nitride (Si3N4) bearing balls, and experimentally validate models. Also investigate advanced Nondestructive Evaluation (NDE) methods for Si3N4 bearing balls and conduct full-scale bearing performance testing of advanced hybrid bearings.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Pulse Detonation Engine (and Laser Induced Thermal Acoustics Instrument).	0.000	2.464	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Assess and validate pulsed detonation propulsion technology from inlet-to-nozzle through free or semi-free jet testing. Enhance capability to demonstrate detonation initiation techniques in an integrated test rig. Conduct test firings with multiple detonation initiation methods in parallel to provide technology risk reduction and alleviate detonation initiation difficulties.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	15.577	18.997	17.292

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0601102F, Defense Research Sciences.									
(U) PE 0602805F, Dual Use Science and Technology.									
(U) PE 0603216F, Aerospace Propulsion and Power Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3048 Fuels and Lubrication

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

eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE: 3066 Turbine Engine Technology	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3066 Turbine Engine Technology	33.769	36.862	33.529	34.433	36.593	37.083	37.517	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the Fiscal Year 2006 Congressionally-directed Notre Dame Center for Flow Physics and Control in the amount of $3.0 million are in the process of being moved to PE 0601102F, Defense Research Sciences, from PE 0602203F, Aerospace Propulsion, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops technology to increase turbine engine operational reliability, durability, mission flexibility, and performance, while reducing weight, fuel consumption, and cost of ownership. Analytical and experimental areas of emphasis are fans and compressors, high temperature combustors, turbines, internal flow systems, controls, augmentor and exhaust systems, integrated power and thermal management systems, engine inlet integration, mechanical systems, and structural design. This project supports the Integrated High Performance Turbine Engine Technology (IHPTET) and Versatile Affordable Advanced Turbine Engine (VAATE) programs, which are joint DoD, NASA, and industry efforts to focus turbine propulsion technology on national needs. The program plan reflects the technology base support for VAATE activity applicable to global responsive strike, capable unmanned warfighting, tactical and global mobility, responsive space lift, and persistent Intelligence, Surveillance, and Reconnaissance.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop core turbofan/turbojet engine components (i.e., compressors, combustors, and high-pressure turbines) for fighters, bombers, sustained supersonic/hypersonic cruise vehicles, and transports. Note: In FY 2006, efforts will further develop advanced concepts, designs, design rules, and computational tools to increase efficiency and operability, decrease weight, and improve durability of axial compressors, combustors, and high pressure turbines (HPT), as well as improve pattern factor and decrease harmful emissions of combustors, and increase HPT cooling effectiveness. These efforts enable aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.	16.361	16.728	17.727

(U) In FY 2005: Rig tested a high-pressure ratio compressor including an assessment of unsteady flow interactions for reduced fuel burn, and high reaction blading and engine stall avoidance techniques for reduced maintenance cost. Concluded full annular aerothermal tests of a trapped vortex combustor. Rig tested an integrated lightweight combustor with a ceramic matrix composite shell and advanced material panels representative of advanced combustor configurations. Completed fabrication and test advanced high-pressure turbine rig hardware to evaluate advanced three-dimensional effects on blade tip heat transfer for increased performance and durability. Enhanced advanced intentional mistuning methodology and completed experimental verification on transonic rig hardware.

(U) In FY 2006: Develop and apply advanced modeling and simulation rules and tools for advanced components (high cycle fatigue, computational fluid dynamics, cycle analyses, propulsion system models, component life models, probabilistic models, etc.). Incorporate advanced materials systems into innovative designs (gamma titanium aluminides, metal matrix composites, ceramics, new metallic alloys, etc.). Develop and extend analytical methods to

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
predict integrally bladed rotor and airfoil durability, and damage tolerance. Conduct bench and rig tests of advanced components for validation, such as an advanced metal foam heat exchanger.			
(U) In FY 2007: Continue to develop and apply advanced modeling and simulation rules and tools for advanced components. Incorporate advanced materials systems into innovative designs and analyze Ceramic Matrix Composite turbine blades, turbine vanes, and turbine rear frame. Design and analyze tiled turbine airfoil technology to reduce cooling flow and increase life. Design and demonstrate a very short, high efficiency afterburner concept. Conduct rig tests and design optimization of effective, durable, radiation barrier coatings to reduce the radiant heat loads on hot section components. Design, fabricate, and rig test fan/radial compressor internal aerodynamics, large radius rotating air seals, a low profile annular combustor, and a large scale casting of fan/radial compressor.			
(U)			
(U) MAJOR THRUST: Develop turbofan/turbojet engine components (i.e., fans, low pressure turbines, engine controls, exhaust nozzles, and integration technologies) for turbofan/turbojet engines for fighters, bombers, sustained supersonic strike and hypersonic cruise vehicles, and transports. Note: In FY 2006, funding increases to support new focus to further develop advanced concepts, designs, design rules, and computational tools to increase efficiency and operability, decrease weight, and improve durability of fans, low pressure turbines (LPT), control systems, augmentors, and exhaust nozzles, as well as increase LPT cooling effectiveness, increase control systems parameters and response, and reduce augmentors observability and screech. These efforts enable aircraft engines to have higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.	10.244	10.475	11.100
(U) In FY 2005: Performed post-test analysis of multi-stage low-pressure rig test data to assess performance of advanced turbine blade configurations applicable to high altitude, long endurance systems. Concluded testing advanced control system hardware using component life models to verify real-time computational capabilities for transitioning this technology to a demonstrator engine program. Concluded analysis and tests of advanced, low-observable compatible augmentor designs, resulting in improved design rules and tools to improve augmentor operability and reduce screech.			
(U) In FY 2006: Develop and apply advanced modeling and simulation rules and tools for advanced components (high cycle fatigue, computational fluid dynamics, cycle analyses, propulsion system models, component life models, probabilistic models, etc.). Apply advanced materials systems to innovative designs (gamma titanium aluminides, metal matrix composites, ceramics, advanced metallic alloys, etc.). Develop new and innovative design concepts, and conduct bench and rig tests of advanced components for validation.			
(U) In FY 2007: Identify and quantify sources of variability and uncertainty affecting turbine blade durability performance (oxidation, creep, thermal material fatigue, high cycle fatigue, etc.). Apply advanced materials systems to innovative designs to determine wear reduction, improve load capacity, and increase temperature capability of five			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	centi-stokes oil and to assess aerodynamics, operability, aeromechanics, and acoustic characteristics of a counter-rotating fan-on-blade (FLADE) concept. Conduct design optimization for turbine blade microcircuit cooling. Test pilot and fuel injection concepts in a single-flameholder rig to evaluate fundamental capabilities.			
(U)				
(U)	MAJOR THRUST: Develop limited life engine components for missile and unmanned air vehicle applications, including long-range supersonic and hypersonic vehicles. These efforts enable engines with reduced cost, reduced fuel consumption, and increased specific thrust, thereby greatly expanding the operating envelopes of missiles and unmanned vehicles.	3.257	3.330	3.530
(U)	In FY 2005: Completed configuration studies and developed conceptual design of an advanced versatile and affordable high-pressure core and low-pressure component configurations for expendable engines using rub tolerant ceramic blades to meet the small engine performance and cost reduction objectives.			
(U)	In FY 2006: Complete conceptual design of an advanced versatile and affordable high-pressure core and low-pressure component configurations for expendable engines using rub tolerant ceramic blades to meet the small engine performance and cost reduction objectives. Apply advanced materials systems to innovative designs and analyze a slinger-fed, dual-fuel compact recirculation combustor (CRC). Develop and apply advanced modeling and simulation rules and tools for advanced components (i.e., high cycle fatigue (HCF), computational fluid dynamics (CFD), cycle analyses, propulsion system models, component life models, probabilistic models, etc.). Complete detailed design, computational fluid dynamics, and perform analyses for a fuel-cooled turbine. Develop new and innovative design concepts, and conduct bench and rig tests of advanced components for validation.			
(U)	In FY 2007: Rig test a slinger-fed, dual-fuel CRC. Continue to develop and apply advanced modeling and simulation rules and tools for advanced components (i.e., high cycle fatigue, computational fluid dynamics, cycle analyses, propulsion system models, component life models, probabilistic models, etc.). Rig test a fuel-cooled turbine. Design and analyze a five-stage forward swept compressor.			
(U)				
(U)	MAJOR THRUST: Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.	1.081	1.105	1.172
(U)	In FY 2005: Enhanced conceptual design of advanced versatile and affordable high-pressure core engine component configurations for turboshaft/turboprop engines to meet the small engine performance and cost reduction objectives			
(U)	In FY 2006: Develop and apply advanced modeling and simulation rules and tools for advanced components (i.e., HCF, CFD, cycle analyses, propulsion system models, component life models, probabilistic models, etc.). Complete conceptual design of advanced versatile and affordable high-pressure core engine component configurations for turboshaft/turboprop engines to meet the small engine performance and cost reduction objectives. Apply advanced			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	materials systems to design and analyze a high heat release combustor. Develop new and innovative design concepts and conduct bench and rig tests of advanced components for validation.			
(U)	In FY 2007: Continue to develop and apply advanced modeling and simulation rules and tools for advanced components. Apply advanced materials systems to innovative designs and analyze a nano-laminate thermal barrier coating. Develop new and innovative design concepts and conduct bench and rig tests of advanced components for validation such as a high heat release combustor.			
(U)				
(U)	CONGRESSIONAL ADD: VAATE-Titanium Matrix Composites.	0.974	1.774	0.000
(U)	In FY 2005: Applied Titanium Matrix Composite materials to an advanced fan design with the goal of increasing performance and/or reducing weight.			
(U)	In FY 2006: Utilize previous Titanium Matrix Composite (TMC) modeling predictions to design and build test scale hardware and initiate response and fatigue testing.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Center for Flow Physics and Control.	1.852	2.957	0.000
(U)	In FY 2005: Conducted experimental and analytical studies to determine optimal diagnostic configuration for new high-speed sensors and actuators to evaluate gaseous flow through a turbine engine. Used results to design more accurate and effective laboratory test facility for engine design.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Notre Dame Center for Flow Physics and Control.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Intelligent Engine Software Development for Advanced Turbine Engines.	0.000	0.493	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Apply advanced intelligent software design methodologies to develop a Universal FADEC that would be applicable to all commercial and military gas turbine engines.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	33.769	36.862	33.529

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Materials:									
(U) PE 0601102F, Defense Research									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology

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

Sciences.

(U) PE 0602102F, Materials.

(U) PE 0603216F, Aerospace Propulsion and Power Technology.

(U) PE 0602122N, Aircraft Technology.

(U) PE 0603210N, Aircraft Propulsion.

(U) PE 0603003A, Aviation Advanced Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE: 3145 Aerospace Power Technology	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3145 Aerospace Power Technology	42.993	44.392	30.364	31.667	33.782	34.309	34.804	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the FY 2006 Congressionally-directed Lightweight Photovoltaic Electricity and Hydrogen for Portable, On-Demand Power for Defense Applications in the amount of $1.0 million are in the process of being moved to PE 0602601F, Space Technology, from PE 0602203F, Aerospace Propulsion, for execution. Funds for the FY 2006 Congressionally-directed Advanced Energy Technology for Munitions - Dominator Program in the amount of $2.8 million are in the process of being moved to PE 0602203F, Aerospace Propulsion, from PE 0602602F, Conventional Munitions, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops techniques for efficient energy conversion/storage, power generation/power conditioning/distribution, and thermal management for military aerospace applications. Power component technologies are developed to increase reliability, maintainability, commonality, and supportability of aircraft and flight line equipment. Research is conducted in energy storage technologies to enable the 10-20 year long-term energy storage goals of Air Force unmanned vehicles. Electrical power generation/power conditioning/distribution and thermal management technologies enable all future military directed energy weapon systems. This project supports development of very high output power systems suitable for applications to air moving target indication radar, high power lasers, and high power microwaves for aerospace platforms. Lightweight power systems suitable for other aerospace applications are also developed.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop power generation/conditioning/distribution, energy conversion/storage, and thermal management component and subsystem technologies for manned and unmanned aircraft systems. These technologies improve aircraft self-sufficiency, reliability, maintainability, and supportability, while reducing life cycle costs and enabling new capabilities. Note: In FY 2005, effort to complete testing of an advanced switched reluctance machine controller was transferred to FY 2007 due to delay in obtaining international project agreement.	11.692	11.249	11.679
(U) In FY 2005: Fabricated and tested small-scale lithium-based solid-state cells. Fabricated and tested modular fuel cell systems for manned and unmanned vehicles. Verified dynamic engine models for power extraction through data analysis by independent model.			
(U) In FY 2006: Develop next generation solid state lithium-based electrolyte and develop thin film cells with high voltage battery cathodes. Perform system design and analysis and develop breadboard of a high power fuel cell system for manned and unmanned vehicles.			
(U) In FY 2007: Fabricate and characterize next generation solid state lithium-based thin film cells. Complete testing of an advanced switched reluctance machine controller.			
(U)			
(U) MAJOR THRUST: Develop thermal management, energy conversion/storage and power conditioning components, and subsystem technologies for aerospace applications.	2.749	4.219	4.019
(U) In FY 2005: Integrated vehicle health monitoring algorithms into power distribution unit. Fabricated and performed			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3145 Aerospace Power Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	initial testing of a silicon carbide packaging concept for power electronic device development.			
(U)	In FY 2006: Complete testing a silicon carbide packaging concept for power electronic device development. Initiate efforts to scale-up sub-scale spray cooling flight tests to ten kilowatt (kW) and expand modeling efforts to support the scale-up. Develop flight experiment for two-phase active thermal management system.			
(U)	In FY 2007: Complete scale-up, modeling efforts and flight tests of ten kW spray cooling technology.			
(U)				
(U)	MAJOR THRUST: Develop cryogenic power generation, high rate batteries, energy conversion/storage and power conditioning components, and system technologies with low volume displacement to enable delivery of high power for operation of directed energy weapons. Note: In FY 2006, increase in funding is due to fabrication and test of superconducting generator.	9.451	14.267	14.666
(U)	In FY 2005: Tested advanced pulse power capacitors. Completed testing of liquid dielectric high voltage switches. Tested Bismuth Strontium Calcium Copper Oxide (BSCCO)/ Yttrium Barium Copper Oxide (YBCO) superconducting coils in a rotating test rig for megawatt-class power applications. Completed scale-up and test high rate lithium-ion (liquid) cells. Initiated preliminary design of proof-of-concept superconducting generator.			
(U)	In FY 2006: Develop conductor configuration, test, and deliver a coil of alternating current tolerant high temperature superconducting material. Initiate preliminary design of high rate lithium-ion (liquid) battery system for directed energy applications. Complete design of proof-of-concept superconducting generator and begin fabrication.			
(U)	In FY 2007: Continue design of high rate lithium-ion (liquid) battery system for directed energy applications. Complete fabrication and begin testing proof-of-concept superconducting generator.			
(U)				
(U)	CONGRESSIONAL ADD: Cell-Level Battery Control.	1.461	0.986	0.000
(U)	In FY 2005: Further developed and improved prototype components for monitoring and control of charge and temperature of battery energy storage systems of battery controller for lithium ion battery in man-portable systems and expand efforts to airborne systems.			
(U)	In FY 2006: The individual Application Specific Integrated Circuits and controller will be applied to an application using Li-ion batteries to form a new power supply for the Battlefield Air Operations (BAO) kit. This technology could also be applied to fighter aircraft or for Unmanned Aerial Vehicles (UAV) batteries.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Lightweight Photovoltaics for Portable Power and Hydrogen Generation. Note: In FY 2005, this was referred to as "Photovoltaic Hydrogen and Flexible Photovoltaic for Portable Power."	0.974	0.986	0.000
(U)	In FY 2005: Continued to investigate various photovoltaic solar cells to determine performance characteristics.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3145 Aerospace Power Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Evaluated device designs to incorporate accomplishments from prior years. Determined designs most likely for success and produced a final design based on this determination.			
(U)	In FY 2006: Fabricate multi-junction solar cells on flexible, thin-film substrates. Develop advanced laser scribing and cell interconnection techniques required for the fabrication of high-performance flexible thin-film solar cells. Fabricate and demonstrate flexible thin film photovoltaic modules of 1 sq.ft. Develop photovoltaic electricity converter (PEC) photoelectrodes for hydrogen generation. Develop hydrogen and oxygen catalyst materials for efficient water electrolysis. Develop efficient and durable PEC systems.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Hypersonic Vehicle Electric Power System (HVEPS) Technology.	3.022	0.000	0.000
(U)	In FY 2005: Fabricated and tested subscale 500 kilowatt (kW) supersonic and 100 kW hypersonic magnetohydrodynamic (MHD) generators using modern commercial cryocoolers for the MHD superconducting magnets and high energy fuels to produce high temperatures and electrical conductivity in the MHD channel.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: High Powered Electrical Aircraft Capabilities (HiPEAC).	6.335	0.000	0.000
(U)	In FY 2005: Identified the technologies required to satisfy the capability requirements of emerging high-powered aircraft. Complete designs, fabrication, and tests of critical technologies required for enabling new platform capabilities. Developed and built a ground-based aircraft electric power test bed to demonstrate system level and component level technologies and drive them to mature technology readiness levels.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Center for Security of Large-Scale Systems (LSS).	1.851	1.380	0.000
(U)	In FY 2005: Improved previous and developed new accurate, high-speed computation for the implementation of fast-acting on-line control to enhance security and survivability of military platforms with specific focus on the application of advanced distributed heterogeneous simulation techniques to LSS. Expanded and conducted tests of prototype hardware used to verify and validate the modeling and simulation accuracy.			
(U)	In FY 2006: Apply high-speed computation, based upon distributed heterogeneous simulation, to develop optimization strategies, prognostics, and health monitoring (PHM) systems for military platforms. Apply Distributed Heterogeneous Optimization (DHO) and PHM to prospective military platforms with specific focus on near-space			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3145 Aerospace Power Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	vehicles and more-electric power-optimized aircraft. Conduct tests and use prototype hardware to validate DHO and PHM strategies.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Remote-Base Power Demonstration.	1.461	0.000	0.000
(U)	In FY 2005: Developed materials systems and cell-stack configurations for increasing the power density and improving start-up characteristics for a five kW Auxiliary Power Unit using advanced solid oxide fuel cell technology.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Integrated Cooling and Power System with Magnetic Bearing Turbogenerator.	2.730	0.000	0.000
(U)	In FY 2005: Analyzed, modeled, and developed the system components comprising a complete Integrated Cooling and Power System (ICPS), integrated the Magnetic Bearing Turbo-Generator (MBTG) with these components, and performed system-level ground tests of the entire MBTG-enabled ICPS package.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: High Flux ESC System with TES for Military High Energy Laser (in FY 2005, this congressional add was titled Advanced Cooling Technology for High Flux Military Diode Laser Arrays).	1.267	1.281	0.000
(U)	In FY 2005: Conducted scaling, reliability, and flight test experiments to advance spray-cooling concepts for high flux laser components for space and air vehicles.			
(U)	In FY 2006: Develop spray cooling technology critical for cooling high heat flux tactical lasers on space and air vehicles. Research will focus on scalability and reliability of the evaporative spray cooling thermal management system (TMS). Effort objective is to scale the TMS to cool up to 30 kW of waste heat with an energy storage capacity of 2 Megajoules (MJ). In addition, the cooling system will be designed and evaluated to operate in harsh environmental conditions such as variable gravity and extreme temperatures.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Affordable Lightweight Power Supply Development.	0.000	1.744	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Demonstrate a novel membrane electrode assembly (MEA) employing advanced electrolyte and/or			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3145 Aerospace Power Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	catalysts with vastly superior performance compared to conventional MEAs at high temperatures and low relative humidity. Further development of these systems to improve longevity and mechanical integrity under harsh operating conditions. Construct and test MEAs of various sizes and short-stack fuel cells with enhanced performance that lead to improved power density, reduction in cost per kW of power and the utilization of high energy fuels.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Integrated Power and Aircraft Technologies.	0.000	5.224	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop and demonstrate an integrated power unit (IPU) as a multi-function turbogenerator with maximized power density (kW/ft3) and minimized logistics requirements. Design and demonstrate an engine-internal generator(s) for propulsion engines for an unmanned aircraft. Develop technologies for superconducting generators of 1-5 Megawatt (MW) power range with minimized size/weight requirements for a generator and its cryocooling subsystem. Develop technologies and dynamic models of a 1-5 MW pulse-power generation system for a directed energy application, with a conventional generator as the power source. Develop simulations and models of this 1-5 MW pulse power system in an aircraft-installed configuration to identify energy flow and thermal management requirements as well as benefits in utilizing recent thermal management technologies. Design, build, and demonstrate various components supporting an "all-electric engine" that does not require an external gearbox drive or its accessories.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: MEPS (Multimegawatt Electric Power System) Thermal Management.	0.000	1.380	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Perform trade studies that investigate the possible thermal management approaches to the removal of heat from a high power microwave and the subsequent elimination of this heat from the airborne weapon/power system. Perform a sub-scale thermal management demonstration of the heat removal technique. Develop a technique that prevents over-temperature damage from occurring to the microwave device in the event that the cooling technique ceases to function properly.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Portable Power Solution Employing Chemical Hydrides.	0.000	1.676	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Aide transition of the fuel cell power unit to the Battlefield Renewable Integrated Tactical Energy			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3145 Aerospace Power Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	System (BRITES) through continued refinement of the energy storage cartridge. Various aspects of the cartridge performance will be examined with respect to orientational dependence, ruggedness, and cost effectiveness. Multiple cartridges will be constructed and evaluated and a detailed analysis of their performance and reliability will be presented. Additionally, advanced methodologies for increasing cartridge energy density will be explored. In particular, non-aqueous fuel hydrolysis will be examined.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	42.993	44.392	30.364

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0601102F, Defense Research Sciences.									
(U) PE 0602102F, Aerospace Flight Dynamics.									
(U) PE 0602605F, Directed Energy Technology.									
(U) PE 0602805F, Dual Use Science and Technology.									
(U) PE 0603605F, Advanced Weapon Technology.									
(U) PE 0603216F, Aerospace Propulsion and Power Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT NUMBER AND TITLE: 33SP Space Rocket Component Tech

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
33SP Space Rocket Component Tech	0.000	0.000	49.305	46.497	48.774	49.726	49.925	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts will transfer from PE 0602500F, Multi-Disciplinary Space Technology, Project 5026, Rocket Propulsion Component Tech, and Project 5027, High Speed Airbreathing Prop Tech, to this BPAC in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops advances in rocket propulsion technologies for space access, space maneuver, and ballistic missiles. Analytical and experimental areas of emphasis are propellants, propellant management, combustion, rocket material applications, Technology for Sustainment of Strategic Systems (TSSS) Phase 1, and novel space propulsion concepts. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of future space and missile launch subsystems. Technologies are developed to reduce the weight and cost of components using new materials and improved designs and manufacturing techniques. All efforts in this project contribute to the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program, a joint Department of Defense, NASA, and industry effort to focus rocket propulsion technology on national needs.

This project also develops revolutionary, airbreathing, hypersonic propulsion technology options to enable affordable, on demand access to space for the Air Force. The short-term focus is on hydrocarbon fueled engines capable of operating over a broad range of Mach numbers and longer term focus will be on hydrogen fueled scramjet powered engines that can enable the higher Mach numbers to achieve access to space. Technologies developed under this program enable capabilities of interest to both the Department of Defense and the NASA. Efforts include modeling and simulation, proof of concept tests of critical components, advanced component development, and ground-based tests.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop, characterize, and test advanced hydrocarbons, energetics, and reduced-toxicity monopropellants to increase space launch payload capability and refine new propellants synthesis methods. Efforts include evaluation and development of reduced-toxicity ionic salt, high-energy-density oxidizers, nano-materials, catalyst, and polymeric binders; determining optimized paths for incorporating these materials into propellants; and for selected propellants perform laboratory and demonstrator engine evaluations. Efforts seek monopropellants with performance equivalent to bipropellants that reduce the cost of space access and space operations. Phases are referring to the IHPRPT program phases.	0.000	0.000	3.259

(U) In FY 2005: Not Applicable.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Further downselect and continue scaling-up promising high energy-density materials candidates. Evaluate scaled-up and new selected propellants in advanced combustion devices to determine materials compatibility and performance to include supporting large-scale motor tests. Continue to model and analyze advanced propulsion concepts with enhanced performance and reliability such as rocket-based combined cycle engines.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 33SP Space Rocket Component Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	MAJOR THRUST: Develop advanced liquid engine combustion technology for improved performance, while preserving chamber lifetime and reliability needs for engine uses in heavy lift space vehicles. Efforts include modeling and analyzing advanced propulsion concepts with enhanced performance and reliability such as aerovehicles and potential launch systems. Phases are referring to the IHPRPT program phases.	0.000	0.000	8.257
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Continue to characterize, study, and evaluate shear coaxial injector performance to ensure chamber/injector compatibility and prevent damage to upper stage engines. Continue to develop, analyze, and transition advanced combustion device technology, including injectors and chambers suitable for advanced synthetic hydrocarbon fuels capable of meeting or exceeding the Phase III goals. Develop improved understanding of fundamental combustion and fluid flow/heat transfer processes leading to new methodologies for thermal management, scaling, and combustion instabilities in hydrocarbon fueled liquid rocket engines, reducing the need for conducting large numbers of costly full-scale component and engine tests. Develop, scale-up, and transition new energetic advanced hydrocarbon fuels and additives for rocket propulsion, including space storable high energy, non-toxic fuels.			
(U)	MAJOR THRUST: Develop advanced material applications for lightweight components and material property enhancements for use in advanced combustion devices and propulsion systems for current and future rocket propulsion systems.	0.000	0.000	4.985
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Continue developing new advanced ablative components using hybrid polymers. Continue to characterize and finalize processing parameters of new nano-reinforced high temperature polymers and scale-up processing of carbon-carbon materials. Continue developing new advanced materials for use with high-energy propellants. Continue to explore using nanocomposites for liquid rocket engine tanks and optimize processing technology using multifunctional nanomaterials.			
(U)				
(U)	MAJOR THRUST: Develop advanced liquid engine technologies for improved performance, while increasing life and reliability needs for engine uses in expendable and reusable launch vehicles.	0.000	0.000	26.539
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Continue development of advanced cryogenic upper stage technologies - turbopumps and thrust			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 33SP Space Rocket Component Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	chambers. Evaluate third set of potential hydrocarbon fuels and adjust/modify/develop fuel characterization test rig. Complete development of second concept for lightweight nozzles for liquid rocket engines. Start hydrocarbon boost technology development for future operationally responsive spacelift concepts.			
(U)				
(U)	MAJOR THRUST: Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for stationkeeping, repositioning, and orbit transfer for large communication satellites, microsatellites, and satellite constellations. Phases are referring to the IHPRPT program phases.	0.000	0.000	6.026
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Continue Hall thruster Phase III development efforts. Continue evaluating Phase III plasma thrusters for microsatellites propulsion systems. Initiate advanced bi-propellant technology developments for satellite thrusters. Initiate advanced hybrid propulsion concept for satellites.			
(U)				
(U)	MAJOR THRUST: Conduct assessments, system design trades, and simulations to integrate combined cycle engines (CCEs) and advanced cycle airbreathing hypersonic propulsion technologies in support of the development of affordable, on-demand access to space vehicles to meet future warfighter needs.	0.000	0.000	0.239
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Conduct system trade studies to determine military payoff and establish component technology goals. Continue to define new component and engine performance objectives to enable development of affordable hypersonic CCEs.			
(U)				
(U)	Total Cost	0.000	0.000	49.305

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Not Applicable.									

(U) D. Acquisition Strategy

Not Applicable

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT NUMBER AND TITLE: 4847 Rocket Propulsion Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4847 Rocket Propulsion Technology	24.711	35.829	15.357	11.132	11.679	11.843	11.974	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops technologies for the sustainment of strategic systems (including solid boost/missile propulsion, post boost control, aging and surveillance efforts) and tactical rockets. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of these systems. Technologies are being accomplished in two phases and are developed to reduce the weight by 15 percent (Phase I)/20 percent (Phase II) and cost of components 25 percent (Phase I)/30 percent (Phase II) through the use of new materials, and improving designs and manufacturing techniques. Aging and surveillance efforts could improve lifetime prediction capabilities by ten years and reduce non-destructive test costs by 50 percent. All efforts in this project are part of the Technology for the Sustainment of Strategic Systems program and support the Integrated High Payoff Rocket Propulsion Technology program.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop missile propulsion and boost technologies for tactical and ballistic missile systems. Efforts support the Technology for the Sustainment of Strategic Systems program - Phase II.	8.769	10.464	7.729

(U) In FY 2005: Enhanced component development and risk reduction efforts for the Phase II ballistic missile technology demonstration. Evaluated a new potential impregnant for use in rapid densification nozzle fabrication technology, using improved strategic propellants for future ballistic missiles to enhance performance and weight. Increased monomer yield from 18 percent to 45 percent, completed downselect for Phase II materials, and furthered demonstration of low-cost, high temperature, non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer components for solid rocket motors. Successfully scaled up from one gallon to ten gallon batches, while formulating and characterizing new propellant formulations using new fuels and oxidizers developed the last couple years for the next phase of advanced solid propulsion. Completed round robin for one model improving agreement between test methodology and understanding while pursuing modeling and simulation tool developments for solid rocket motors. Furthered the development of advanced tactical propulsion components with improved synthesis yield in a precursor used in propellant formulation.

(U) In FY 2006: Enhance component development and risk reduction efforts for the Phase II ballistic missile technology demonstration. Continue development of rapid densification nozzle technology using improved strategic propellants for future ballistic missiles to enhance performance and weight. Continue demonstrating low-cost, high temperature, non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer components for solid rocket motors. Complete formulation and characterization of new propellant formulations using new fuels and oxidizers developed over the last couple of years for the next phase of advanced solid propulsion. Continue modeling and simulation tool developments for solid rocket motors to be used in developing components for the Phase II Missile Propulsion Demonstration. Continue development of advanced tactical propulsion technologies.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 4847 Rocket Propulsion Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Initiate component development and risk reduction efforts for the Phase II Missile Propulsion demonstration. Verify development of rapid densification nozzle technology using improved strategic propellants for future ballistic missiles to enhance performance and weight. Continue demonstrating low-cost, high temperature, non-erosive, lightweight coated carbon-carbon, ceramic and hybrid polymer components for solid rocket motors. Continue development of advanced tactical propulsion technologies. Complete modeling and simulation tool developments for solid rocket motors to be used in developing components for the Phase II Missile Propulsion Demonstration.			
(U)				
(U)	MAJOR THRUST: Develop missile propulsion technologies and aging and surveillance technologies for ballistic missile. Efforts support the Technology for the Sustainment of Strategic Systems program Phase II.	1.762	1.412	7.628
(U)	In FY 2005: Completed the development of analytical solutions to polymer mechanics for the Phase II aging and surveillance technology developments in analysis codes, tools, and inspection tools for improved assessment of ballistic missile aging characteristics and status.			
(U)	In FY 2006: Complete analysis of existing sensor technologies for use in assessment of ballistic missile aging characteristics and status. Initiate an advanced service life prediction technology program developing and applying existing and advanced sensors that can be embedded or attached to solid rocket motors and the aging and surveillance models and tools that can translate and integrate the sensor data into existing aging and surveillance tool suite.			
(U)	In FY 2007: Continue advanced service life prediction technology program developing and applying existing and advanced sensors that can be embedded or attached to solid rocket motors and the aging and surveillance models and tools that can translate and integrate the sensor data into existing aging and surveillance tool suite.			
(U)				
(U)	CONGRESSIONAL ADD: Advanced Vehicle and Propulsion Center (AVPC).	3.899	4.238	0.000
(U)	In FY 2005: Performed technical support for the analysis of alternatives (AOA) for the following key Air Force missions: prompt global strike; land-based strategic deterrent; and operationally responsive space lift.			
(U)	In FY 2006: Perform technical support and analysis for the Prompt Global Strike Analysis of Alternatives (AoA). Conduct facility upgrades to support upcoming testing which support planning efforts for Land-based Strategic Deterrent and Operationally Responsive Spacelift activities.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Jet and Rocket Engine Test Site (JRETS) testing at San Bernardino International Airport.	6.627	17.743	0.000
(U)	In FY 2005: Expanded the test capabilities to include a spacecraft environmental testing capability and upgrade test			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 4847 Rocket Propulsion Technology

(U)	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	capabilities at each test stand.			
(U)	In FY 2006: Funds are expected to bring the remainder of the JRETS test capabilities to a fully operational status in support of government and commercial jet and rocket engine test programs.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Advanced Aerospace Vehicle Cooling Technologies. Note: Only to conduct evaluations of aerospace vehicle cooling technologies at the Jet & Rocket Engine Test Site (JRETS) rockets test stand at the San Bernardino International Airport.	0.974	0.000	0.000
(U)	In FY 2005: Performed Congressionally-directed effort for evaluating aerospace vehicle cooling technologies.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Aerospace Lab Equipment Upgrade.	0.974	0.986	0.000
(U)	In FY 2005: Obtained subsonic wind tunnel equipment for university educational and research purposes.			
(U)	In FY 2006: Obtain high speed and visualization tools for university educational and research purposes.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: High Regression Rate Hybrid Rocket Fuels.	0.732	0.986	0.000
(U)	In FY 2005: Conducted analytical and experimental studies to evaluate the feasibility to mature high regression rate hybrid rocket fuels for use in space launch vehicles.			
(U)	In FY 2006: Conduct scale-up testing and technology maturation efforts for high regression rate hybrid rocket fuels for use in space launch vehicles.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Engineering Research Laboratory Equipment Upgrade.	0.974	0.000	0.000
(U)	In FY 2005: Obtained mechanical engineering equipment for university educational and research purposes.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	24.711	35.829	15.357

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 4847 Rocket Propulsion Technology

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

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

(U) Related Activities:

(U) PE 0601102F, Defense Research Sciences.

(U) PE 0602114N, Power Projection Applied Research.

(U) PE 0602303A, Missile Technology.

(U) PE 0602500F, Multi-Disciplinary Space Tech.

(U) PE 0603311F, Ballistic Missile Technology.

(U) PE 0603401F, Advanced Spacecraft Technology.

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

(U) D. Acquisition Strategy

Not Applicable.