PE NUMBER: 0603216F
PE TITLE: Aerospace Propulsion and Power Technology

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

	Cost ($ in Millions)	FY 2004 Actual	FY 2005 Estimate	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	86.720	86.050	77.268	86.690	88.391	92.907	94.858	96.622	Continuing	TBD
2480	Aerospace Fuels	3.352	0.371	0.196	2.834	4.743	5.156	5.262	5.358	Continuing	TBD
3035	Aerospace Power Technology	3.207	5.250	4.028	5.588	6.044	4.542	4.636	4.723	Continuing	TBD
4921	Aircraft Propulsion Subsystems Int	26.887	22.420	18.430	14.172	24.777	26.841	27.408	27.918	Continuing	TBD
4922	Space & Missile Rocket Propulsion	11.649	5.986	6.627	4.784	4.787	5.191	5.301	5.400	Continuing	TBD
5098	Advanced Aerospace Propulsion	14.433	26.069	23.212	33.780	22.494	23.471	23.964	24.411	Continuing	TBD
681B	Advanced Turbine Engine Gas Generator	27.192	25.954	24.775	25.532	25.546	27.706	28.287	28.812	Continuing	TBD

Note: In FY 2005-2007, a portion of the funding in Projects 2480 and 4921 was shifted to Project 5098.

(U) 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 power generation and storage, 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 and Atmospheric Propulsion project develops and demonstrates improved hydrocarbon fuels and advanced propulsion systems for high-speed/hypersonic flight. The Aerospace Power Technologies project develops and demonstrates power and thermal systems for weapons and aircraft. The Advanced Turbine Engine Gas Generator (ATEGG) project develops and demonstrates core turbine engine technologies for current and future aircraft propulsion systems. The Aerospace Propulsion Subsystem Integration project integrates the engine cores demonstrated in the ATEGG project with low-pressure components into demonstrator engines. Turbine engine propulsion projects within this program are part of the Integrated High Performance Turbine Engine Technology and the Versatile Affordable Advanced Turbine Engine programs. 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). Finally, the Space and Missile Rocket Technology project develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques. Rocket propulsion projects within this program are part of the Integrated High Payoff Rocket Propulsion Technology program, which includes the area of Technology for the Sustainment of Strategic Systems. Note: In FY 2005, Congress added $1.0 million for Advanced Satellite Thermal Control Program; $2.4 million for Versatile Affordable Advanced Turbine Engine; and $3.5 million for Integrated High Performance Turbine Engine Technology Phase III Technology Demonstrator. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

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

		FY 2004	FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	93.425	79.914	68.626	74.950
(U)	Current PBR/President's Budget	86.720	86.050	77.268	86.690
(U)	Total Adjustments	-6.705	6.136		
(U)	Congressional Program Reductions				
	Congressional Rescissions		-0.764		
	Congressional Increases		6.900		
	Reprogrammings	-2.347			
	SBIR/STTR Transfer	-4.358			
(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: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

PROJECT NUMBER AND TITLE: 2480 Aerospace Fuels

Cost ($ in Millions)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2480 Aerospace Fuels	3.352	0.371	0.196	2.834	4.743	5.156	5.262	5.358	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2005-2007, a protion of the funding in this project was shifted to Project 5098 in this PE.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates improved hydrocarbon fuels and advanced, novel aerospace propulsion systems, including systems for high-speed/hypersonic flight and technology 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 developing and 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 develops 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. This project is integrated into the Versatile Affordable Advanced Turbine Engine program.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
	0.868	0.060	0.025	0.989

(U) MAJOR THRUST: Demonstrate thermally stable fuels and fuel system hardware concepts to enhance cooling capacity (performance), minimize fuel coking, and reduce fuel system maintenance. Note: Due to FY 2005-2007 funding shifts, the FY 2004-2005 high heat sink fuel technologies demonstration efforts were slipped for completion in post-FY 2007.

(U) In FY 2004: Studied, tested, and demonstrated, at a pilot-light level, advanced high-heat sink fuels and hardware concepts that can increase fuel delivery system durability and performance at high temperatures and can reduce maintenance due to fuel degradation in aircraft fuel systems and engine control hardware. Developed bread-board, on-engine fuel additive injection hardware. Demonstrated long-term JP-8+225 performance in bench and full-scale fuel systems. Initiated demonstrations of the performance of fuel developed from alternative (non-petroleum) sources in reduced scale fuel system simulators.

(U) In FY 2005: Continue to study, test, and demonstrate, at a pilot-light level, advanced high heat sink fuels and hardware concepts that can increase fuel delivery system durability and performance at high temperatures and reduce maintenance due to fuel degradation in an aircraft fuel system and engine control hardware.

(U) In FY 2006: Continue to study, test, and demonstrate at a pilot-light level, advanced high heat sink fuels including those produced from alternative energy resources and hardware concepts that can increase engine performance at high temperatures, improve fuel system durability, and reduce maintenance due to fuel degradation in aircraft and engine hardware.

(U) In FY 2007: Continue to study, test, and demonstrate, advanced high heat sink fuels including those produced from alternative energy resources and hardware concepts that can increase engine performance

Exhibit R-2a, RDT&E Project Justification			DATE: February 2005
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	at high temperatures, improve fuel system durability, and reduce maintenance due to fuel degradation in aircraft and engine hardware. Initiate demonstrations of fuel performance at fuel temperatures in the supercritical regime.				
(U)					
(U)	MAJOR THRUST: Determine fuel cooling requirements and specifications for advanced aircraft sensors and directed energy weapons that will meet the needs of evolving manned systems and unmanned aerial vehicle (UAVs). Note: Due to FY 2005-2007 funding shifts, the FY 2004-2005 UAV fuel additive efforts were revised for a restart in post-FY 2007.	0.448	0.147	0.025	0.500
(U)	In FY 2004: Demonstrated, at a pilot-light level, low temperature additives for use in jet fuel to allow advanced manned and unmanned systems to sustain high altitude loiter for extended periods. Refined the design and building an UAV fuel system/tank simulator to study low temperature fuel behavior. Demonstrated additive performance in aircraft like fuel system simulator.				
(U)	In FY 2005: Continue pilot-light level demonstrations of low temperature additives for use in jet fuel to allow advanced manned and unmanned systems to sustain high altitude loiter for extended periods with focus on combustion performance of additized fuels.				
(U)	In FY 2006: Continue, at a pilot-light level, to study, test, and demonstrate advanced fuels for UAV applications including advanced low temperature fuels and fuels to enable extended range and duration.				
(U)	In FY 2007: Demonstrate advanced low temperature and enhanced performance fuels for UAV applications focusing on technologies that expand the flight envelope, range, or duration of UAVs to include advanced thermal management concepts.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate efficacy of low-cost, environmentally friendly fuel additives to reduce soot particulate emissions from gas turbine engines using advanced research combustors and small turbine engines. Note: Due to FY 2005-2007 funding shifts, the FY 2005 combined cycle engine fuel additive efforts were revised for a restart in post-FY 2007.	0.867	0.060	0.025	0.500
(U)	In FY 2004: Advanced pilot-light level demonstrations of additives that reduce soot emissions by at least 50 percent. Developed additives to improve ignition and combustion characteristics in current and advanced propulsion concepts, including combined cycle engines. Qualified additives through material compatibility, toxicology, and hot section tests, and demonstrated additive effectiveness in engine component tests.				
(U)	In FY 2005: Continue pilot-light level demonstrations of additives that reduce soot emissions by at least 50 percent.				
(U)	In FY 2006: Continue pilot-light level demonstrations of additives that reduce soot emissions by at least 50 percent.				

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(U)	In FY 2007: Demonstrate advanced additives to reduce soot and nitrogen oxides emissions in advanced propulsion concepts including combined cycle engines.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate enhancements to fuel system technology. Note: Due to FY 2005-2007 funding shifts, the FY 2005 combined cycle engine candidate/hardware efforts were revised for a restart in post-FY 2007.	0.737	0.057	0.025	0.345
(U)	In FY 2004: Designed and developed concept hardware and fuel system simulators to evaluate key high temperature fuel system components of reusable aerospace vehicles, focusing on aerospace vehicles with advanced and combined cycle engines that require high levels of fuel cooling. Improved characterization of hydrocarbon fuel candidates and enhanced hardware concepts for combined cycle engines.				
(U)	In FY 2005: Continue pilot-light level design and development of hardware and fuel system simulators to evaluate key high temperature fuel system components of reusable aerospace vehicles focusing on aerospace vehicles with advanced and combined cycle engines that require high levels of fuel cooling.				
(U)	In FY 2006: Continue pilot-light level design and development of hardware and fuel system simulators to evaluate key high temperature fuel system components of reusable aerospace vehicles focusing on aerospace vehicles with advanced and combined cycle engines that require high levels of fuel cooling.				
(U)	In FY 2007: Continue design, development, and demonstration of hardware and fuel system simulators to evaluate key high temperature fuel system components of reusable aerospace vehicles focusing on aerospace vehicles with advanced and combined cycle engines that require high levels of cooling.				
(U)					
(U)	MAJOR THRUST: Identify, develop, and demonstrate low-cost approaches to reducing the fuel logistics footprint for the Expeditionary Air Force. Note: Due to FY 2005-2007 funding shifts, the FY 2005 novel nozzle efforts were revised for a restart in post-FY 2007.	0.432	0.047	0.096	0.500
(U)	In FY 2004: Furthered pilot-light development of novel methods for fuel analysis and additization in order to extend the usable temperature range of commercially available aviation fuel through application of novel technologies, including biologically related approaches. Demonstrated applicability of rapid fuel screening and identification using chromatography-based statistical analysis methods and commercially available fuel analyzers.				
(U)	In FY 2005: Continue pilot-light development of novel methods including bio- and nano-technology for fuel analysis.				
(U)	In FY 2006: Continue pilot-light development of novel methods including bio- and nano-technology for fuel analysis.				
(U)	In FY 2007: Demonstrate advanced nano-technology fuel additives, nano-technology fuel sensors, and novel detection and mitigation technologies for biological growth.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
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(U)

(U) Total Cost	3.352	0.371	0.196	2.834

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

	FY 2004 Actual	FY 2005 Estimate	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 0602203F, Aerospace Propulsion.										
(U) PE 0602102F, Materials.										
(U) PE 0602204F, Aerospace Sensors.										
(U) PE 0603112F, Advanced Materials for Weapons Systems.										
(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 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

PROJECT NUMBER AND TITLE: 3035 Aerospace Power Technology

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3035	Aerospace Power Technology	3.207	5.250	4.028	5.588	6.044	4.542	4.636	4.723	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates electrical power generation, energy storage, thermal management, and distribution systems for aerospace applications. This technology enhances reliability and survivability, and reduces vulnerability, weight, and life cycle costs for manned and unmanned aerospace vehicles. The electrical power system components developed are projected to provide a two- to five-fold improvement in aircraft reliability and maintainability, and a 20 percent reduction in power system weight. This project also develops and demonstrates high power generation, energy storage, and thermal management technologies to enable high power density sources for directed energy weapons.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop power generation and conditioning, high rate batteries, and energy storage component and subsystem technologies for integration of high power subsystems with directed energy weapons (DEW). These technologies will enable the delivery of high power for operation of DEW. Note: FY 2005 low duty cycle generator system efforts have been delayed until FY 2006 and FY 2006 synergistic efforts have been delayed to FY 2007 to allow for multi-megawatt superconducting Applied Research activities to more fully develop. In FY 2006, the megawatt superconducting power system demonstration activity will be moved to a separate effort in this Project.	0.912	1.701	0.990	0.907
(U) In FY 2004: Completed fabrication and tests of a high power, low duty cycle generator critical components for pulsed DEWs.				
(U) In FY 2005: Initiate analysis of power system integration into an airframe as part of a non-lethal weapon system. Initiate preliminary design of and develop analytical model for a megawatt class power system demonstrator.				
(U) In FY 2006: Develop technology roadmaps and complete analysis of power system integration into an airframe as part of a non-lethal weapon system. Initiate design for a megawatt non-superconducting low duty cycle generator system tailored to directed energy weapons.				
(U) In FY 2007: Complete design and perform modeling and simulation of a megawatt non-superconducting low duty cycle generator system tailored to directed energy weapons.				
(U)				
(U) MAJOR THRUST: Develop power generation/conditioning/distribution component, energy storage, and thermal management components and subsystem technologies for manned and unmanned aircraft systems. These technologies will improve aircraft self-sufficiency, reliability, maintainability, and supportability, while reducing life cycle costs and enabling new capabilities. Note: In FY 2006, this	1.566	1.795	1.267	0.000

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activity will be completed.

(U) In FY 2004: Initiated design of the demonstration electrical generator for integration into mid-thrust class engines. Fabricated and tested large amp-hour (200) cells and batteries.

(U) In FY 2005: Complete detailed design of demonstration electrical generator for integration into mid-thrust class engines.

(U) In FY 2006: Complete engine integration and test of the internal starter generator in mid-thrust class engines.

(U) In FY 2007: Not Applicable.

(U)

(U) MAJOR THRUST: Develop power generation/conditioning/distribution, energy storage, and thermal management components and subsystem technologies that are synergistic with aerospace and weapons platforms.	0.729	0.763	0.000	1.450

(U) In FY 2004: Fabricated low volume/low weight high temperature motor drive.

(U) In FY 2005: Test low volume/low weight high temperature motor drive.

(U) In FY 2006: Not Applicable. Note: The FY 2006 synergistic efforts will be delayed to FY 2007 to allow for multi-megawatt superconducting Applied Research activities to more fully develop.

(U) In FY 2007: Investigate alternative energy storage/generation systems for low power applications.

(U)

(U) MAJOR THRUST: Develop analytical tools and subsystems for multi-megawatt superconducting electrical power systems including power generation, conditioning, and dynamic interaction. Note: Prior to FY 2006, the megawatt superconducting power system demonstration activity was included in the directed energy weapons effort in this Project.	0.000	0.000	1.771	3.231

(U) In FY 2004: Not Applicable.

(U) In FY 2005: Not Applicable.

(U) In FY 2006: Complete preliminary design for a megawatt class power system demonstrator.

(U) In FY 2007: Initiate detailed design of megawatt class power system demonstrator and begin fabrication of key components.

(U)

(U) CONGRESSIONAL ADD: Advanced Satellite Thermal Control Program.	0.000	0.991	0.000	0.000

(U) In FY 2004: Not Applicable.

(U) In FY 2005: Expand Electrochromics Coatings (EC) productions beyond the pilot scale level, develop processes incorporating EC into thin flexible films that can be bonded to satellite structures and test EC devices in real application environments.

(U) In FY 2006: Not Applicable.

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(U) In FY 2007: Not Applicable.

(U) Total Cost	3.207	5.250	4.028	5.588

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

	FY 2004 Actual	FY 2005 Estimate	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 0602201F, Aerospace Flight Dynamics.										
(U) PE 0602203F, Aerospace Propulsion.										
(U) PE 0602605F, Directed Energy Technology.										
(U) PE 0603605F, Advanced Weapons Technology.										
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

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BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

PROJECT NUMBER AND TITLE: 4921 Aircraft Propulsion Subsystems Int

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4921	Aircraft Propulsion Subsystems Int	26.887	22.420	18.430	14.172	24.777	26.841	27.408	27.918	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2005-2007, a portion of the funding in this project was shifted to Project 5098 in this PE.

(U) 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. This project includes the Aerospace Propulsion Subsystems Integration (APSI) program which includes demonstrator engines such as the Joint Technology Demonstrator Engine for manned systems and the Joint Expendable Turbine Engine Concept for unmanned air vehicle 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, these efforts include activities under the national High Cycle Fatigue program. This project also focuses on system integration of inlets, nozzles, engine/airframe compatibility, and power and thermal management subsystems technologies. APSI 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. APSI supports the goals of the national Integrated High Performance Turbine Engine Technology (IHPTET) program, which is focused on doubling turbine engine propulsion capabilities while reducing cost of ownership. Anticipated technology advances include turbine engine improvements providing an approximate 30 percent reduction in tactical fighter aircraft takeoff gross weight and 100 percent increase in aircraft range/loiter. APSI is also fully integrated into the Versatile Affordable Advanced Turbine Engine program (VAATE). The IHPTET and VAATE programs provide continuous technology transition for military turbine engine upgrades and derivatives, and have the added dual-use benefit of enhancing the United States turbine engine industry's international competitiveness.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Design, fabricate, and demonstrate durability and integration technologies for turbofan/turbojet engines. These technologies will improve durability, supportability, and affordability of current and future Air Force aircraft. Note: In FY 2004, the Air Force refocused turbine efforts to complete the IHPTET by 2005 causing sustained supersonic engines advancement efforts to be reduced in FY 2004 and future efforts to be delayed until FY 2006. Additionally, as a consolidation process, these efforts were shifted to the improved performance and fuel consumption effort in this Project.	5.744	1.777	1.400	1.300

(U) In FY 2004: Completed structural durability tests of an engine and performance tests of the Joint Technology Demonstrator Engine containing fixed inlet guide vanes and a Moderate Aspect Ratio rotor, fan rim damper, High Cycle Fatigue mistuning and damping technologies, vaneless counter-rotating high/low pressure turbine, probabilistic rotor system design, sprayform cast turbine case, and a high fuel/air ratio Impingement Film Floatwall Combustor. Initiated advanced engine designs for a sustained supersonic engine with advanced aero, a low pressure turbine with advanced thermal barrier coatings and

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microcircuit cooling scheme, thermoplastic externals and health monitoring.

(U) In FY 2005: Validate the High Cycle Fatigue Test Protocol by completing structural durability tests of advanced engine components and instrumentation.

(U) In FY 2006: Design and develop agile combat support engine technologies to increase durability of components to include advanced aerodynamics for fans, turbines, mechanical systems, interactions between the inlet and fan, and controls/accessories.

(U) In FY 2007: Fabricate and test agile combat support engine technologies to increase durability of components to include advanced aerodynamics for fans, turbines, mechanical systems, interactions between the inlet and fan, and controls/accessories.

(U)

(U) MAJOR THRUST: Design, fabricate, and test advanced component technologies for improved performance and fuel consumption of turbofan/turbojet engines for fighters, bombers, sustained supersonic and hypersonic cruise vehicles, and transports. Each of these component technology innovations can be applied to a significant part of the Air Force's engine inventory and offer potentially significant performance enhancements to future aircraft engineers. Note: In FY 2004 and FY 2005, for the Low Pressure Turbine efforts, Ceramic Matrix Composites (CMCs) replaced Organic Matrix Composites (OMCs) due to maturity of the technology.	14.806	11.925	11.374	9.022

(U) In FY 2004: Completed fabrication, instrumentation, and assembly, and initiated test of a High Cycle Fatigue (HCF) robust front frame, an affordable OMC fan frame, a multi-stage forward swept fan, a damped low-pressure turbine (LPT) blade, a Titanium Matrix Composite (TMC) shaft, and model-based flexible control with diagnostics in an advanced demonstrator engine. Enhanced advanced engine designs for an uncooled CMC LPT blade and completed design of a carbon counter-rotating intershaft seal and active augmentor screech control.

(U) In FY 2005: Complete test of a HCF robust front frame, an affordable OMC fan frame and duct, a multi-stage forward swept fan, a damped LPT blade, a TMC shaft, and model-based flexible control with diagnostics. Complete advanced engine designs with an uncooled CMC LPT blade and begin fabrication of multi-property rotor, fluidic control and modulated turbine cooling.

(U) In FY 2006: Complete fabrication and testing multi-property rotor, fluidic control, and modulated turbine cooling. Initiate advanced designs for lightweight engine (utilizes a hollow fan, radial compressor, and low profile combustor) capable of operating as primary propulsion or in a lift mode. Initiate advanced engine designs for a sustained supersonic engine using variable cycle features, an advanced fan, improved turbine using cooled metal and cooled CMCs, and lightweight CMC cases and ducts.

(U) In FY 2007: Enhance advanced designs for lightweight high bypass engine (utilizes a hollow fan, radial

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	compressor, and low profile combustor) capable of operating as primary propulsion or in a lift mode. Enhance advanced engine designs for a sustained supersonic engine using variable cycle features, an advanced fan, improved turbine using cooled metal and cooled CMCs, and lightweight CMC cases and ducts.				
(U)					
(U)	MAJOR THRUST: Design, fabricate, and test advanced component technologies for limited life engines. These technologies improve the performance, durability, and affordability of engines for missile and unmanned air vehicles (UAVs), and subsonic to hypersonic weapon applications.	3.921	2.870	5.656	3.850
(U)	In FY 2004: Completed engine structural durability testing a high stage loading splittered fan and uncooled ceramic low-pressure turbine. Completed testing of an uncooled ceramic high-pressure turbine, and slinger combustor. Completed testing a low volume combustor. Completed fabrication and conducted durability test an uncooled Ceramic Matrix Composite turbine blisk/nozzle, and a Carbon/Carbon exhaust nozzle. Initiated designs of advanced component technologies for intelligent and durability engine test.				
(U)	In FY 2005: Enhance designs of advanced component technologies for intelligent and durability engine testing for UAVs. Initiate designs of advanced component technologies for intelligent and durability engine testing to include an advanced fan/compressor, a ceramic turbine, turbine with new advanced cooling approach, and improved oil-less bearings.				
(U)	In FY 2006: Enhance design and begin fabrication of advanced high temperature cooled turbine blade and combustor for UAV applications. Enhance designs of advanced components for technologies for intelligent and durability engine testing to include an advanced fan/compressor, a ceramic turbine, turbine with new advanced cooling approach, and oil-less bearings.				
(U)	In FY 2007: Continue fabrication of advanced high temperature cooled turbine blade and combustor for UAV applications. Begin fabrication of advanced components for technologies for intelligent and durability engine testing to include an advanced fan/compressor, a ceramic turbine, turbine with new advanced cooling approach, and oil-less bearings.				
(U)					
(U)	CONGRESSIONAL ADD: IHPTET Phase III Technology Demonstrator. Note: In FY 2004, this was referred to as "Advanced Turbine Engine Gas Generator and Aircraft Propulsion Subsystem Integration."	2.416	3.469	0.000	0.000
(U)	In FY 2004: Designed and fabricated advanced component technologies for improved performance and fuel consumption of turbofan/turbojet engines for fighters, bombers, and transports. Refurbished, fabricated, instrumented, and assembled hardware from the advanced turbine engine gas generator. This gas generator will be used in engine testing the following components: two-stage forward swept fan; uncooled CMC low pressure turbine vane; Titanium Matrix Composite shaft; and model-based flexible				

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control with diagnostics. Each of these component technology innovations can be applied to the Air Force's engine inventory and offer potentially significant performance enhancements to future aircraft engines.

(U) In FY 2005: Complete design, fabrication, instrumentation, assembly, and test of a multi-stage forward swept fan, an uncooled CMC low pressure turbine blade, and fluidic thrust vectoring in an advanced demonstrator engine.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Not Applicable.

(U)

(U) CONGRESSIONAL ADD: VAATE. Note: Only for the XTC 58F/1 for purposes demonstrating the integration of individual technologies for highly fuel efficient 10,000-15,000 pound thrust demonstrator engines needed for evolving UAVs.	0.000	2.379	0.000	0.000

(U) In FY 2004: Not Applicable.

(U) In FY 2005: Initiate designs of advanced component technologies (includes an advanced fan and improved high temperature turbine blades) for intelligent and durability engine testing for UAVs.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Not Applicable.

(U) Total Cost	26.887	22.420	18.430	14.172

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

	FY 2004 Actual	FY 2005 Estimate	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 0602201F, Aerospace Flight Dynamics.										
(U) PE 0602203F, Aerospace Propulsion.										
(U) PE 0603003A, Aviation Advanced Technology.										
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 4921 Aircraft Propulsion Subsystems Int

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

PROJECT NUMBER AND TITLE: 4922 Space & Missile Rocket Propulsion

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4922	Space & Missile Rocket Propulsion	11.649	5.986	6.627	4.784	4.787	5.191	5.301	5.400	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates 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, 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 systems, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy propellants. Technological advances developed in this program are being accomplished in two phases and that could improve the performance of expendable systems' payload capabilities by approximately 15 percent (Phase I)/20 percent (Phase II) and reduce hardware and operation costs by approximately 25 percent (Phase I)/30 percent (Phase II). Aging and Surveillance efforts that could improve lifetime prediction capabilities by 10 years and reduce non-destructive test costs by 50 percent. The projects in this program are part of the Technologies 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 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate missile propulsion and Post Boost Control Systems (PBCS) technologies for ballistic missiles.	7.024	2.417	2.284	0.970
(U) In FY 2004: Demonstrated component technologies with readily available materials to reduce hardware costs with increased performance for the PBCS. Furthered hardware development integrating case, nozzle, insulation, and propellant for the Missile Propulsion Demonstration Phase I.				
(U) In FY 2005: Complete Phase I full-scale risk reduction component developments for the advanced PBCS demonstration. Complete demonstration of component technologies with readily available materials to reduce hardware costs with increased performance for the PBCS. Enhance hardware development integrating case, nozzle, insulation, and propellant for the Missile Propulsion Demonstration Phase I.				
(U) In FY 2006: Continue hardware development integrating case, nozzle, insulation, and propellant for the Missile Propulsion Demonstration Phase I.				
(U) In FY 2007: Complete the Missile Propulsion Demonstration Phase I.				
(U)				
(U) MAJOR THRUST: Develop and demonstrate missile propulsion, PBCS, aging, and surveillance technologies for strategic systems. Efforts support the Technology for Sustainment of Strategic Systems Phase II. Note: The FY 2005 start of subcomponent development for the propulsion demonstration efforts was delayed to FY 2007 to allow for modeling and simulation tools to mature. After FY 2006, the aging and surveillance efforts in this activity will become a separate activity in this project.	4.625	3.569	3.943	3.208

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 4922 Space & Missile Rocket Propulsion

(U) In FY 2004: Completed initial development of advanced modeling and simulation tools (Phase II) applying them to actual missile components for verification, design, and modification. Began development of advanced aging and surveillance models and tools to further improve capability to analyze and predict motor life and system health.

(U) In FY 2005: Continue modeling and simulation tools (Phase II) development for analyzing and developing missile components. Complete this development effort of aging and surveillance tools for predicting the health of solid rocket motors. Develop methods to apply these tools on a motor-by-motor basis vice a fleet wide basis.

(U) In FY 2006: Continue modeling and simulation tools (Phase II) development for analyzing and developing missile components.

(U) In FY 2007: Begin development of subcomponents to test the accuracy of the previously developed modeling and simulation tools and update the models with the resulting data for use in an upcoming Missile Propulsion demonstration.

(U)

(U) MAJOR THRUST: Develop and demonstrate aging and surveillance technologies for strategic systems to improve lifetime prediction capabilities by 10 years and reduce non-destructive test costs by 50 percent. Efforts support the Technology for Sustainment of Strategic Systems Phase II. Note: Prior to FY 2006, the aging and surveillance efforts were part of another effort in this Project.	0.000	0.000	0.400	0.606
(U) In FY 2004: Not Applicable.				
(U) In FY 2005: Not Applicable.				
(U) In FY 2006: Complete development of aging and surveillance tools for predicting the health of solid rocket motors and methods to apply these tools on a motor-by-motor basis vice a fleet wide basis.				
(U) In FY 2007: Initiate scale-up activities for an advanced service life prediction program integrating existing and advanced sensors, models, and tools to be able to predict the service life of a solid rocket motor on a motor-by-motor basis.				
(U) Total Cost	11.649	5.986	6.627	4.784

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

	FY 2004 Actual	FY 2005 Estimate	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 0602102F, Materials.										
(U) PE 0602203F, Aerospace Propulsion.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603216F Aerospace Propulsion and Power Technology**	PROJECT NUMBER AND TITLE **4922 Space & Missile Rocket Propulsion**

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

(U) PE 0602601F, Spacecraft Technology.

(U) PE 0603401F, Advanced Spacecraft Technology.

(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Tec.

(U) PE 0603853F, Evolved Expendable Launch Vehicle Program.

(U) PE 0603114N, Power Projection 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 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

PROJECT NUMBER AND TITLE: 5098 Advanced Aerospace Propulsion

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5098	Advanced Aerospace Propulsion	14.433	26.069	23.212	33.780	22.494	23.471	23.964	24.411	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2005-2007, funds were shifted to accelerate the Air Force scramjet flight demonstration efforts. In 2007, funding increases to support ground demonstrations and fabricate test vehicles for out-year flight demonstrations.

(U) 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 necessary to support aircraft and weapon platforms operating over the range of Mach 0 to 8+. 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.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate technologies for a hydrocarbon-fueled scramjet with robust operation over a range of Mach 4 to 8.	14.433	26.069	23.212	33.780

(U) In FY 2004: Designed and fabricated a fixed geometry flow-path for a hydrocarbon-fueled scramjet with robust operations over a range of Mach 4.5 to 7+ to include optimization of the flow-path cross-section and the flame-holding/fuel-mixing geometry. Developed a robust engine start system to achieve full engine light after boost to Mach 4.5. Initiated design of an active engine sense-control system to manage start transient and engine mode changes during acceleration. Initiated vehicle design capable of rocket-boost to Mach 4, full integration with scramjet engine and hydrocarbon fuel system, and acceleration from Mach 4.5 to 7+. Initiated selection of rocket boosters.

(U) In FY 2005: Ground test the flight weight hydrocarbon-fueled, fixed geometry flow path. Demonstrate engine start and control systems. Continue detailed design of the scramjet engine demonstrator air vehicle. Conduct wind tunnel tests of the air vehicle models to determine aerodynamic forces and moments and vehicle stability and control. Conduct various design trade studies to ready the overall demonstrator design (includes air vehicle structures, avionics, instrumentations, scramjet propulsion systems, and boosters) for a critical design review.

(U) In FY 2006: Continue detailed design of the scramjet engine demonstrator air vehicle. Complete vehicle subsystem trade studies and designs for structures, avionics, instrumentation, booster and other necessary technologies. Conduct multiple risk reduction tests and analyses to reduce both aerodynamic and

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 5098 Advanced Aerospace Propulsion

propulsion uncertainties prior to Critical Design Review. Conduct extensive transonic, supersonic, and hypersonic wind tunnel tests and simultaneously conduct computational fluid dynamics analyses of tested configurations. Conduct aero-thermodynamic tests to ensure vehicle thermal protection system design meets requirements. Conduct additional propulsion related risk reduction tests to mature propulsion system subcomponents (hot gas valves, digital engine controller, fuel pump) and broaden the engine ground test matrix to better align with expected flight profiles.

(U) In FY 2007: Complete engine and vehicle designs and conduct vehicle critical design review. Fabricate and test flight clearance engine and initiate fabrication of flight engines. Establish flight test profiles and margins. Initiate fabrication of air vehicle flight hardware and begin flight test preparations at supporting test centers.

(U) Total Cost					14.433	26.069	23.212	33.780	

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

	FY 2004 Actual	FY 2005 Estimate	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 0602102F, Materials										
(U) PE060203F, Aerospace Propulsion										
(U) This project will be 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 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

PROJECT NUMBER AND TITLE: 681B Advanced Turbine Engine Gas Generator

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
681B	Advanced Turbine Engine Gas Generator	27.192	25.954	24.775	25.532	25.546	27.706	28.287	28.812	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) 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, reparability, and maintainability can be assessed in a real engine environment. The gas generator, or core, is the basic building block of the engine and it consists of a compressor, a combustor, a high-pressure turbine, mechanical systems, and core subsystems. Experimental core engine testing enhances early, 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) test. 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. The core performances of this project are proven in demonstrator engines in Project 4921 of this PE. Efforts are part of the IHPTET and the VAATE programs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Design, fabricate, and performance test demonstration core engines, using advanced materials to provide greater durability, improved performance, and reduced fuel consumption for turbofan/turbojet engines for fighters, attack aircraft, bombers, sustained supersonic and hypersonic cruise vehicles, and large transports. Each of these technology innovations can be applied to a significant part of the Air Force's engine inventory and offer potentially significant performance enhancements to future aircraft engines, thus enabling new capabilities for faster, survivable, durable, more responsive systems with longer range and greater payloads. Note: In FY 2005, funding was redirected to refocused Air Force priorities that address propulsion needs for new capabilities such as advanced fighter-attack, precision long-range strike, persistent high-altitude endurance, and agile combat support.	22.532	21.635	21.334	21.980

(U) In FY 2004: Completed advancement of hardware fabrication of a core engine test article with advanced compressor aerodynamics, a trapped vortex combustor with ceramic matrix composite combustor liners, magnetic bearings, and advanced turbine blisk and vane materials. Improved the design of hardware for core engine test of a high-pressure ratio six-stage compressor with an integrated lightweight combustor with integrated vane pack, a cooled cooling air system, and micro-circuit cooled high pressure turbine blades with advanced thermal barrier coating.

(U) In FY 2005: Complete design and fabrication of hardware for testing a cooled-cooling air system,

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 681B Advanced Turbine Engine Gas Generator

micro-circuit cooled high pressure turbine blades, and blade outer air seals with advanced thermal barrier coating. Perform risk reduction tests of a magnetic bearing system for an advanced core engine. Initiate conceptual studies and preliminary designs of advanced core engine technologies, including systems level technologies residing within the core.

(U) In FY 2006: Complete preliminary design and begin detailed design of advanced core engine technologies, including advanced turbine blade materials incorporating next generation cooling schemes, novel coatings to reduce combustor and turbine heat loads, ceramic turbine components, and systems for active control, thermal management, and power extraction. Begin preliminary design and risk reduction planning for a tip turbine concept, including a novel compression system, innovative annular combustor, and advanced rotating seals. Begin design of unique compression system components.

(U) In FY 2007: Complete detailed design and begin fabrication of advanced core engine technologies, including advanced turbine blade materials incorporating next generation cooling schemes, novel coatings to reduce combustor and turbine heat loads, ceramic turbine components, and systems for active control, thermal management, and power extraction. Complete preliminary design and risk reduction planning for a tip turbine concept, including a novel compression system, innovative annular combustor, and advanced rotating seals. Continue design and begin fabrication of unique compression system components.

(U)

(U) MAJOR THRUST: Design, fabricate, and durability test demonstration core engines to provide increased durability and affordability for turbofan/turbojet engines for fighters, attack aircraft, bombers, sustained supersonic and hypersonic cruise vehicles, and large transports. Note: Beginning in FY 2006, this effort will be transferred to the remaining thrusts in this project since durability efforts are integral to Air Force turbine efforts.	1.506	1.500	0.000	0.000

(U) In FY 2004: Enhanced the design and furthered the fabrication of long lead hardware for turbine engine advanced core evaluations in the national durability program.

(U) In FY 2005: Complete the design and fabrication of long lead hardware for evaluation in the national durability program.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Not Applicable.

(U)

(U) MAJOR THRUST: Design, fabricate, and evaluate technology demonstration core engines to provide improved performance, greater durability, and lower fuel consumption for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft and runway independent air vehicles, special operations aircraft, theater transports, and large unmanned air vehicles.	3.154	2.819	3.441	3.552

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603216F Aerospace Propulsion and Power Technology**	PROJECT NUMBER AND TITLE **681B Advanced Turbine Engine Gas Generator**

(U) In FY 2004: Conducted core engine tests of a forward swept splittered compressor rotor, a high temperature rise combustor, a counter-rotating vaneless turbine, ceramic matrix composite turbine blades and vanes, and magnetic bearings.

(U) In FY 2005: Complete core engine tests of a forward swept splittered compressor rotor, a high temperature rise combustor, a counter-rotating vaneless turbine, ceramic matrix composite turbine blades and vanes, and magnetic bearings. Initiate design of small versatile affordable core engine technologies.

(U) In FY 2006: Further the design and begin selective risk reduction tests of UAV small versatile affordable advanced core engine technologies including a high heat release combustor, durable high performance turbine, nanolaminate coatings, and systems for thermal management and advanced power extraction. Begin planning for multi-Service demonstration of heavy fuel engine technologies for future rotorcraft.

(U) In FY 2007: Complete design, initiate hardware fabrication, and continue selective risk reduction tests of UAV small versatile affordable advanced core engine technologies including a high heat release combustor, durable high performance turbine, nanolaminate coatings, and systems for thermal management and advanced power extraction. Continue planning for multi-Service demonstration of heavy fuel engine technologies for future rotorcraft.

(U) Total Cost	27.192	25.954	24.775	25.532

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

	FY 2004 Actual	FY 2005 Estimate	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 0602201F, Aerospace Flight Dynamics.										
(U) PE 0602203F, Aerospace 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.