

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 2002	
BUDGET ACTIVITY 03 - Advanced Technology Development				PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology					
COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	41,722	121,548	85,650	72,863	66,163	69,350	71,480	Continuing	TBD
2480 Aerospace Fuels and Atmospheric Propulsion	3,417	12,380	7,675	8,201	8,248	9,292	10,329	Continuing	TBD
3035 Aerospace Power Technology	2,688	4,602	6,240	4,312	4,390	4,475	4,560	Continuing	TBD
4921 Aircraft Propulsion Subsystems Int	0	37,479	35,783	28,914	25,217	26,671	27,116	Continuing	TBD
4922 Space & Missile Rocket Propulsion	0	30,607	1,464	1,507	1,553	1,617	1,664	Continuing	TBD
681B Advanced Turbine Engine Gas Generator	35,617	36,480	34,488	29,929	26,755	27,295	27,811	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0
<p>Note: In FY 2002, all turbine engine technology efforts performed in PE 0603202F, Project 668A, are transferred to PE 0603216F, Project 4921. Also in FY 2002, all rocket propulsion technology efforts performed in PE 0603302F, Projects 4373 and 6340, are transferred to PE 0603216F, Project 4922, in order to align projects with the Air Force Research Laboratory organization. In FY 2003, space unique tasks in Project 4922 will be transferred to PE 0603500F, Project 5033, in conjunction with the Space Commission recommendation to consolidate all space unique activities.</p> <p>In FY 2003, this program anticipates receiving \$4.4 million from the Cost of War Transfer Account. These funds are not included in the FY 2003 Air Force baseline. Funding will be used for rocket propulsion technologies in support of the Technology for Sustainment of Strategic Systems program.</p>									

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<p>(U) <b><u>A. Mission Description</u></b>                  This program develops and demonstrates technologies to achieve enabling and revolutionary advances in turbine and rocket propulsion, power generation and storage, and fuels. The program has five projects, each focusing on technologies with high potential to enhance performance of existing and future Air Force weapons systems. 1) The Advanced Turbine Engine Gas Generator project develops and demonstrates core turbine engine technologies for current and future aircraft propulsion systems. 2) The Aerospace Propulsion Subsystem Integration project integrates the engine cores demonstrated in the Turbine Gas Generator project with low-pressure components into demonstrator engines. 3) The Aerospace Power Technologies project develops and demonstrates power technologies for weapons and aircraft. 4) The Space and Missile Rocket Technology project develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques. 5) The Aerospace Fuels and Atmospheric Propulsion project develops and demonstrates improved hydrocarbon fuels and advanced propulsion systems for hypersonic flight. Turbine engine propulsion projects are part of the Integrated High Performance Turbine Engine Technology (IHPTET) program. Rocket propulsion projects within this program are part of the Integrated High Payoff Rocket Propulsion Technology (IHRPT) program. Note: In FY 2002, Congress added \$2.0 million for the Joint Expendable Turbine Engine Concept demonstrator; \$4.4 million for the IHRPT program; and \$2.0 million for Vectored Thrust Ducted Propeller Compound Helicopter Demonstration for Combat Rescue.</p>																																																									
<p>(U) <b><u>B. Budget Activity Justification</u></b>                  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.</p>																																																									
<p>(U) <b><u>C. Program Change Summary (\$ in Thousands)</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="text-align: right;"><u>FY 2001</u></th> <th style="text-align: right;"><u>FY 2002</u></th> <th style="text-align: right;"><u>FY 2003</u></th> <th style="text-align: right;"><u>Total Cost</u></th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget</td> <td style="text-align: right;">43,413</td> <td style="text-align: right;">114,335</td> <td style="text-align: right;">96,161</td> <td></td> </tr> <tr> <td>(U) Appropriated Value</td> <td style="text-align: right;">43,814</td> <td style="text-align: right;">122,735</td> <td></td> <td></td> </tr> <tr> <td>(U) Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding-left: 20px;">a. Congressional/General Reductions</td> <td></td> <td style="text-align: right;">-1,187</td> <td></td> <td></td> </tr> <tr> <td style="padding-left: 20px;">b. Small Business Innovative Research</td> <td style="text-align: right;">-1,029</td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding-left: 20px;">c. Omnibus or Other Above Threshold Reprogram</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding-left: 20px;">d. Below Threshold Reprogram</td> <td style="text-align: right;">-662</td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding-left: 20px;">e. Rescissions</td> <td style="text-align: right;">-401</td> <td></td> <td></td> <td></td> </tr> <tr> <td>(U) Adjustments to Budget Years Since FY 2002 PBR</td> <td></td> <td></td> <td style="text-align: right;">-10,511</td> <td></td> </tr> <tr> <td>(U) Current Budget Submit/FY 2003 PBR</td> <td style="text-align: right;">41,722</td> <td style="text-align: right;">121,548</td> <td style="text-align: right;">85,650</td> <td style="text-align: right;">TBD</td> </tr> </tbody> </table>				<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Total Cost</u>	(U) Previous President's Budget	43,413	114,335	96,161		(U) Appropriated Value	43,814	122,735			(U) Adjustments to Appropriated Value					a. Congressional/General Reductions		-1,187			b. Small Business Innovative Research	-1,029				c. Omnibus or Other Above Threshold Reprogram					d. Below Threshold Reprogram	-662				e. Rescissions	-401				(U) Adjustments to Budget Years Since FY 2002 PBR			-10,511		(U) Current Budget Submit/FY 2003 PBR	41,722	121,548	85,650	TBD
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BUDGET ACTIVITY	PE NUMBER AND TITLE	
<b>03 - Advanced Technology Development</b>	<b>0603216F Aerospace Propulsion and Power Technology</b>	
<p>(U) <u>C. Program Change Summary (\$ in Thousands) Continued</u></p> <p>(U) <u>Significant Program Changes:</u> FY 2003 decreases are primarily due to transfer of space unique activities to PE 0603500F, Project 5033.</p>		

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)</b>								DATE <b>February 2002</b>			
BUDGET ACTIVITY <b>03 - Advanced Technology Development</b>				PE NUMBER AND TITLE <b>0603216F Aerospace Propulsion and Power Technology</b>				PROJECT <b>2480</b>			
COST (\$ in Thousands)			FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
2480	Aerospace Fuels and Atmospheric Propulsion		3,417	12,380	7,675	8,201	8,248	9,292	10,329	Continuing	TBD
<p>(U) <b><u>A. Mission Description</u></b>          This project develops and demonstrates improved hydrocarbon fuels and advanced, novel aerospace propulsion systems, including systems for hypersonic flight and access to space. Emphasis is on developing and demonstrating new thermally stable, high heat sink, and controlled chemically reacting fuels. The project also develops and demonstrates fuel system components that minimize cost, reduce maintenance, and improve performance of future aerospace systems.</p> <p>(U) <b><u>FY 2001 (\$ in Thousands)</u></b></p> <p>(U) \$810      Continued demonstrating thermally stable JP-8+100 high heat sink fuel that reduces fuel system maintenance on current aircraft and provides greater cooling capacity (performance) for upgraded and future aircraft and missiles. Demonstrated, in a sub-scale fuel system simulator, the effects/benefits of thermally stable JP-8+225 and other high heat sink fuels that reduce fuel system maintenance for advanced fighter configurations.</p> <p>(U) \$770      Demonstrated effectiveness of thermally stable JP-8+100 for reduced maintenance in a variety of aircraft. Fabricated a sub-scale integrated fuel/air heat exchanger-combustor in a cooling air heat exchanger configuration, using fuel/air heat exchanger technology designed and fabricated in FY 2000.</p> <p>(U) \$385      Demonstrated low-cost fuel-additive approaches to control particulate emissions from gas turbine engines. Demonstrated concepts for improving ignition and combustion in advanced engines.</p> <p>(U) \$1,452      Initiated investigation of a broad range of technologies to support propulsion capabilities, improve the nation's aerospace research, development, and manufacturing base, and address the growing shortfall within the aerospace specialized technological workforce. The focus is on propulsion concepts and technologies for next generation military aerospace vehicles. These propulsion concepts will enable practical sustained hypersonic flight and affordable, routine military access to space.</p> <p>(U) \$3,417      Total</p>											
Project 2480			Page 4 of 22 Pages				Exhibit R-2A (PE 0603216F)				

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BUDGET ACTIVITY		PROJECT
<b>03 - Advanced Technology Development</b>		<b>2480</b>
PE NUMBER AND TITLE		
<b>0603216F Aerospace Propulsion and Power Technology</b>		
<b>(U) A. Mission Description Continued</b>		
<b>(U) FY 2002 (\$ in Thousands)</b>		
(U) \$3,950	Develop techniques for merging the scramjet with other engine cycles such as rockets and gas turbine engines to enable responsive, reliable, operable, and affordable access to space. Evaluate options to enable variable geometry scramjet technology. Initiate development of variable geometry scramjet flow path. Develop inlet system for air-breathing space access vehicles requiring multiple scramjet engine modules to enable fuller dominance of space. Design, fabricate, and initiate wind tunnel testing of a sub-scale multiple scramjet engine inlet system. Quantify scramjet inlet mass capture and boundary layer characteristics of each module resulting from multi-engine interactions.	
(U) \$3,450	Develop high fidelity analytical tools to evaluate combined cycle engine options (e.g., gas turbine and ramjet/scramjet combinations) for next generation aerospace vehicles and their weapons for long-range strike. Identify key combined/combo cycle engine technologies to maximize the use of vehicle speed in force miniaturization and platform survivability for a capability beyond low observables. Conduct analyses to identify optimum transition Mach number between gas turbine engine and ramjet/scramjet engine cycles and the maximum cruise speed of the ramjet/scramjet engine. Conduct pre-design study to evaluate force-multiplier and bomber survivability as a function of maximum sustainable flight Mach number achievable with select gas turbine based combined/combo cycle engine options.	
(U) \$1,000	Develop enhanced high heat sink endothermic fuel system cooling technology to enable responsive, reliable, operable, and affordable access to space. Determine optimum operating conditions to ensure low catalyst coking and high efficiency cooling. Begin evaluation of advanced fuel/additive combinations to improve ignition and aerospace vehicle operational characteristics. Design and fabricate subscale hardware to assess component operability and durability in small scale simulators.	
(U) \$1,000	Evaluate advanced high heat sink fuels and advanced fuel cooling technology for next generation aerospace vehicles for long range strike. Determine requirements for fuel/fuel additive combinations to improve component life and durability, improve fuel efficiency, reduce weight, and enable operation of advanced propulsion cycles. Develop comprehensive test and qualification strategy for advanced high heat sink fuels. Initiate design and fabrication of reduced scale fuel system simulation components unique to next generation bombers.	
(U) \$251	Demonstrate thermally stable fuels to enhance cooling capacity (performance) and reduce fuel system maintenance. Demonstrate advanced high heat sink fuels to increase fuel delivery system durability at high temperatures and reduce maintenance due to fuel degradation in a sub-scale integrated fuel/air heat exchanger.	
(U) \$402	Determine fuel cooling requirements for advanced aircraft sensors and directed energy weapons to meet the needs of evolving manned and unmanned aerospace systems. Determine properties for low temperature additives to prevent fuel from freezing and allow advanced unmanned and manned systems to sustain high altitude loiter for extended periods.	
(U) \$797	Develop low-cost fuel additives for Air Force applications. Evaluate and demonstrate optimum low-cost fuel additive to reduce particulate	
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<b>03 - Advanced Technology Development</b>	<b>0603216F Aerospace Propulsion and Power Technology</b>	<b>2480</b>
<b>(U) <u>A. Mission Description Continued</u></b>		
<b>(U) <u>FY 2002 (\$ in Thousands) Continued</u></b>		
	emissions from gas turbine engines by 50 percent. Evaluate and demonstrate low-cost fuel additives to improve ignition characteristics and combustion in current and advanced and combined cycle engines.	
<b>(U) \$800</b>	Develop fuel system technology. Design and develop fuel system simulators to evaluate key high temperature fuel system components of reusable aerospace vehicles. The focus will be on aerospace vehicles with advanced and combined cycle engines that require high levels of fuel cooling. Identify fuel concepts to maximize performance of advanced and combined cycle engines and minimize logistics costs.	
<b>(U) \$730</b>	Identify and develop low-cost approaches to reducing the fuel logistics footprint for the Expeditionary Air Force. Determine benefits of advanced additive packages to improve any commercially available jet fuel to meet military standards. Develop novel methods to inject additives to improve fuels and advanced field diagnostic techniques such as smart nozzles to assess fuel quality, additive injection requirements, and aid in mission planning by monitoring mission limiting fuel properties.	
<b>(U) \$12,380</b>	Total	
<b>(U) <u>FY 2003 (\$ in Thousands)</u></b>		
<b>(U) \$700</b>	Demonstrate thermally stable fuels to enhance cooling capacity (performance) and reduce fuel system maintenance. Continue to study, test, and demonstrate advanced high heat sink fuels that can increase fuel delivery system durability at high temperatures and reduce maintenance due to fuel degradation in a sub-scale integrated fuel/air heat exchanger. Demonstrate long-term JP-8+225 performance in a fuel system simulator.	
<b>(U) \$400</b>	Continue determination of fuel cooling requirements for advanced aircraft sensors and directed energy weapons to meet the needs of evolving manned and unmanned aerospace systems. Develop requirements for low temperature additives to prevent fuel from freezing to allow advanced manned and unmanned systems to sustain high altitude loiter for extended periods. Refine design and build Unmanned Aerial Vehicle fuel system/tank simulator to study high and low temperature fuel behavior.	
<b>(U) \$800</b>	Develop low-cost fuel additives for Air Force applications. Continue performing demonstration testing with low-cost fuel additives to reduce particulate emissions from gas turbine engines by 50 percent and to improve ignition characteristics and combustion in current and advanced propulsion concepts including combined cycle engines. Demonstrate effectiveness of particulate mitigation additives in a full-scale engine test.	
<b>(U) \$400</b>	Develop fuel system technology. Continue design and development of fuel system simulators to evaluate key high temperature fuel system components of reusable aerospace vehicles. The focus will be on aerospace vehicles with advanced and combined cycle engines that require high levels of fuel cooling. Continue investigation of fuel concepts to maximize performance of advanced or combined cycle engines and	
<b>Project 2480</b>	<b>Page 6 of 22 Pages</b>	<b>Exhibit R-2A (PE 0603216F)</b>

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BUDGET ACTIVITY		PROJECT
<b>03 - Advanced Technology Development</b>		<b>2480</b>
PE NUMBER AND TITLE		
<b>0603216F Aerospace Propulsion and Power Technology</b>		
(U)	<b><u>A. Mission Description Continued</u></b>	
(U)	<b><u>FY 2003 (\$ in Thousands) Continued</u></b>	
	minimize logistic costs. Complete characterization of hydrocarbon fuel candidates for combined cycle engines.	
(U)	\$875	Identify and develop low-cost approaches to reducing the fuel logistics footprint for the Expeditionary Air Force. Determine benefits of advanced additive packages to improve any commercially available jet fuel to meet military standards. Develop novel methods to inject additives packages to improve fuels and advanced field diagnostic techniques such as smart nozzles to assess fuel quality, additive injection requirements, and aid in mission planning by monitoring mission limiting fuel properties. Demonstrate field-capable concept for fuel identification and characterization.
(U)	\$4,500	Continue development of high fidelity analytical tools to evaluate combined cycle engine options, such as gas turbine and ramjet/scramjet combinations, for next generation aerospace vehicles and their weapons for long-range strike. Continue evaluation of advanced (ramjet/scramjet) and combined cycle engine options for next generation aerospace vehicles and their weapons for long-range strike. Develop key engine technologies to maximize the use of vehicle speed in force miniaturization and platform survivability for a capability beyond low-observables. Continue to conduct analyses and experiments to optimize component technologies for transition between gas turbine engine and ramjet/scramjet engine cycles, and to optimize cruise speed of ramjet/scramjet engines. Continue to conduct pre-design study to evaluate force-multiplier and bomber survivability as a function of flight Mach number achievable for next generation aerospace vehicles and their weapons.
(U)	\$7,675	Total
(U)	<b><u>B. Project Change Summary</u></b>	
	Not Applicable.	
(U)	<b><u>C. Other Program Funding Summary (\$ in Thousands)</u></b>	
(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)	PE 0603253, Advanced Sensor Integration.	
(U)	This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.	
Project 2480		Exhibit R-2A (PE 0603216F)

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
<b>03 - Advanced Technology Development</b>	<b>0603216F Aerospace Propulsion and Power Technology</b>	<b>2480</b>
<p>(U) <b><u>D. Acquisition Strategy</u></b> Not Applicable.</p> <p>(U) <b><u>E. Schedule Profile</u></b> (U) Not Applicable.</p>		
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<b>BUDGET ACTIVITY</b> <b>03 - Advanced Technology Development</b>	<b>PE NUMBER AND TITLE</b> <b>0603216F Aerospace Propulsion and Power Technology</b>	<b>PROJECT</b> <b>3035</b>
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	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3035      Aerospace Power Technology	2,688	4,602	6,240	4,312	4,390	4,475	4,560	Continuing	TBD

(U) **A. Mission Description**  
 This project develops and demonstrates aircraft and ground power technology for engine starters, auxiliary power units, and electrical power generation and distribution systems. This technology enhances reliability and survivability; it reduces vulnerability, weight, and life cycle costs for (manned and unmanned) aircraft and spacecraft. The electric power system components developed are projected to provide a two to five times improvement in aircraft reliability and maintainability, and a 20 percent reduction in power system weight. This project also develops and demonstrates high power generation and storage technologies to enable high power density sources for directed energy weapons.

(U) **FY 2001 (\$ in Thousands)**

(U) \$752      Designed, fabricated, and tested an electrical distribution system which ensures fault tolerant architecture, improving aircraft reliability and survivability. Performed testing of the demonstrator aircraft on-board Integrated Power Unit (IPU). The demonstrator integrated the switched reluctance starter generator with magnetic bearings and the turbomachine to demonstrate IPU feasibility, weight savings, and reliability improvements over conventional Auxiliary Power Unit/Emergency Power Unit approaches.

(U) \$0      Design, fabricate, and test for emergency power capabilities of an IPU. Applications include rapid rotor spin-up and light-off, and continuous power generation using stored oxidizer.

(U) \$1,936      Developed power generation, conditioning, and distribution; energy storage; and thermal management component and subsystem technologies for manned and unmanned aircraft systems. Test IPU prognostics health management and power electronics for increased reliability, decrease maintenance, and two times increase in power density, which is enabling for advanced fighter aircraft and Uninhabited Combat Aerial Vehicles. Performed trade studies and requirements definitions for advanced motor drives applicable to fuel pumps and flight control actuators.

(U) \$2,688      Total

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<b>03 - Advanced Technology Development</b>	<b>0603216F Aerospace Propulsion and Power Technology</b>	<b>3035</b>
<b>(U) <u>A. Mission Description Continued</u></b>		
<b>(U) <u>FY 2002 (\$ in Thousands)</u></b>		
(U) \$2,000	Develop high-density secondary power system and advanced weapons power technology for a next generation aerospace vehicle for long range strike. Initiate trade studies, detailed design, and critical technology development to optimize secondary power system size, weight, and efficiency. Evaluate electric power technology options for advanced weapon systems.	
(U) \$236	Develop cryogenic power generation, high rate batteries, energy storage and power conditioning components, and system technologies with low volume displacement for delivery of high power to operate directed energy weapons. Fabricate lengths of Yttrium Barium Copper Oxide sufficient to fabricate coated conductors for cryogenic generators.	
(U) \$777	Develop power generation, conditioning, and distribution; energy storage; and thermal management component and subsystem technologies for manned and unmanned aircraft systems. Demonstrate technologies for an integrated power unit for advanced fighter aircraft and unmanned vehicles.	
(U) \$1,589	Define requirements for high power generation systems for directed energy weapons. Evaluate trade offs and define approaches for superconducting and conventional generators for weapons power systems.	
(U) \$4,602	Total	
<b>(U) <u>FY 2003 (\$ in Thousands)</u></b>		
(U) \$933	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. Develop high power low duty cycle generator for pulsed directed energy weapons. Continue to fabricate lengths of Yttrium Barium Copper Oxide sufficient to fabricate coated conductors for cryogenic generators.	
(U) \$1,155	Develop power generation, conditioning, and distribution component; energy 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. Develop power generator system that is closely coupled with propulsion system.	
(U) \$2,152	Develop power generation, conditioning and distribution; energy storage; and thermal management component and subsystem technologies that are synergistic with air, space, and weapons platforms. Demonstrate advanced power conditioning technologies with motor drives and lithium ion batteries that provide reductions in both volume and weight.	
(U) \$2,000	Continue to develop and demonstrate high-density secondary power system and advanced weapons power technology for a next generation aerospace vehicle for long-range strike. Conduct trade studies, detailed design, and critical technology development to optimize secondary	
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COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4921 Aircraft Propulsion Subsystems Int	0	37,479	35,783	28,914	25,217	26,671	27,116	Continuing	TBD

Note: In FY 2002, all turbine engine technology efforts performed in PE 0603202F, Project 668A, are transferred into this project.

- (U) **A. Mission Description**  
 This project develops and demonstrates gas turbine propulsion system technologies applicable to aircraft. The APSI project 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, and exhaust nozzles. This project also focuses on system integration aspects of inlets, nozzles, engine/airframe compatibility, and low-observable technologies. Aerospace Propulsion Subsystems Integration (APSI) provides aircraft with potential for longer range and higher cruise speed 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. The APSI project 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 a ~30 percent reduction in tactical fighter aircraft takeoff gross weight and 100 percent increase in aircraft range/loiter. The IHPTET program provides continuous technology transition for military turbine engine upgrades and derivatives, and has the added dual-use benefit of enhancing the United States turbine engine industry's international competitiveness. Note: In FY 2002, Congress added \$2 million for Joint Expendable Turbine Engine Concept demonstrator engine.
- (U) **FY 2001 (\$ in Thousands)**  
 (U) \$0 Previously accomplished in PE 0603202F, Project 668A.  
 (U) \$0 Total
- (U) **FY 2002 (\$ in Thousands)**  
 (U) \$5,778 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. Complete engine testing in support of the national High Cycle Fatigue program including forward swept fan blade damage tolerance, advanced instrumentation, model validation, and improved test protocol.

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<b>03 - Advanced Technology Development</b>	<b>0603216F Aerospace Propulsion and Power Technology</b>	<b>4921</b>
<b>(U) <u>A. Mission Description Continued</u></b>		
<b>(U) <u>FY 2002 (\$ in Thousands) Continued</u></b>		
<b>(U) \$20,100</b>	Design, fabricate, and demonstrate advanced component technologies for improved performance and fuel consumption of turbofan/turbojet engines for fighters, bombers, and transports. Complete demonstrator engine test of fixed inlet guide vanes and Moderate Aspect Ratio rotor, Integrally Bladed Rotor (IBR) repair, fan rim damper, High Cycle Fatigue (HCF) mistuning technologies, vaneless counterrotating high/low pressure turbine, probabilistic rotor system design, gamma titanium aluminide Low Pressure Turbine (LPT) coverplate, sprayform cast hardware, and Ceramic Matrix Composite (CMC) technologies. Continue advanced engine designs for HCF robust front frame, two-stage forward swept fan, tiled LPT blade, uncooled CMC LPT blade, and model-based control with diagnostics.	
<b>(U) \$6,120</b>	Design, fabricate, and demonstrate advanced component technologies for limited life engines. These technologies improve performance, durability, and affordability of engines for missile and unmanned air vehicle applications. Complete design and fabricate Organic Matrix Composite (OMC) fan, high stage loading splattered fan, uncooled ceramic high/low pressure turbine, slinger and low volume combustors. Complete engine testing the high stage loading splattered fan and uncooled ceramic low pressure turbine in a demonstrator engine.	
<b>(U) \$3,500</b>	Develop high speed turbine engine technology for next generation aerospace vehicles for long range strike. Initiate study to evaluate gas turbine technologies for long range strike vehicles (e.g., gas turbine and ramjet/scramjet combined/combo cycle engines). Initiate integrated design of turbine engine controls, exhaust nozzles, high temperature material components, and mechanical systems for capability beyond low observables.	
<b>(U) \$1,981</b>	Develop turbine engines that reduce fuel consumption, increase thrust/airflow ratio, and reduce production costs for supersonic expendable and limited life unmanned vehicle turbine engines. This is the goal of the Joint Expendable Turbine Engine Concept demonstrator, an important demonstrator in the Integrated High Performance Turbine Engine Technology program. Perform design, fabrication, assembly, and test of materials and high pressure ratio technologies. These technologies include single crystal Lamilloy blades and advanced thermal barrier coated cast cool vanes.	
<b>(U) \$37,479</b>	Total	
<b>(U) <u>FY 2003 (\$ in Thousands)</u></b>		
<b>(U) \$6,177</b>	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. Complete engine structural durability testing of fixed inlet guide vanes and Moderate Aspect Ratio rotor, IBR repair, fan rim damper, HCF mistuning and damping technologies, vaneless counter-rotating high/low pressure turbine, probabilistic rotor system design, gamma titanium aluminide LPT coverplate, sprayform cast hardware, and CMC	
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		February 2002
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
<b>03 - Advanced Technology Development</b>	<b>0603216F Aerospace Propulsion and Power Technology</b>	<b>4921</b>
<p>(U) <b><u>A. Mission Description Continued</u></b></p> <p>(U) <b><u>FY 2003 (\$ in Thousands) Continued</u></b></p> <p>(U) \$20,800      Design, fabricate, and test advanced component technologies for improved performance and fuel consumption of turbofan/turbojet engines for fighters, bombers, and transports. Complete advanced engine designs and initiate fabrication of HCF robust front frame, affordable OMC fan frame, two-stage forward swept fan, tiled Low Pressure Turbine (LPT) blade, uncooled Ceramic Matrix Composite (CMC) LPT blade, Metal Matrix Composite shaft and model-based flexible control with diagnostics. Initiate advanced engine designs for tandem fan with Organic Matrix Composite (OMC) tip shroud, carbon counter-rotating intershaft seal, and active augmentor screech control. 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 engines.</p> <p>(U) \$5,306      Design, fabricate, and test advanced component technologies for limited life engines. These technologies improve performance, durability, and affordability of engines for missile and unmanned air vehicle applications. Complete fabrication and conduct testing on an OMC fan, uncooled ceramic high pressure turbine, slinger combustor. Complete fabrication of low volume combustor. Complete engine structural durability testing of high stage loading splittred fan and uncooled ceramic low pressure turbine.</p> <p>(U) \$3,500      Develop high speed turbine engine technology for next generation aerospace vehicles for long-range strike. Complete study to evaluate gas turbine technologies for long-range strike vehicles (e.g., gas turbine and ramjet/scramjet combined/combination cycle engines). Continue integrated design and initiate long lead hardware for turbine engine controls, exhaust nozzles, high temperature material components, and mechanical systems for capability beyond low-observables.</p> <p>(U) \$35,783      Total</p> <p>(U) <b><u>B. Project Change Summary</u></b> Not Applicable.</p> <p>(U) <b><u>C. Other Program Funding Summary (\$ in Thousands)</u></b></p> <p>(U) Related Activities</p> <p>(U) PE 0602201F, Aerospace Flight Dynamics.</p> <p>(U) PE 0602203F, Aerospace Propulsion.</p> <p>(U) PE 0602122N, Aircraft Technology.</p> <p>(U) PE 0603210N, Aircraft Propulsion.</p>		
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<p>(U) <b><u>C. Other Program Funding Summary (\$ in Thousands)</u></b></p> <p>(U) PE 0603003A, Aviation Advanced Technology.</p> <p>(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication</p> <p>(U) <b><u>D. Acquisition Strategy</u></b> Not Applicable.</p> <p>(U) <b><u>E. Schedule Profile</u></b></p> <p>(U) Not Applicable.</p>		
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<b>BUDGET ACTIVITY</b> <b>03 - Advanced Technology Development</b>	<b>PE NUMBER AND TITLE</b> <b>0603216F Aerospace Propulsion and Power Technology</b>	<b>PROJECT</b> <b>4922</b>
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COST (\$ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4922      Space & Missile Rocket Propulsion	0	30,607	1,464	1,507	1,553	1,617	1,664	Continuing	TBD

Note: In FY 2002, all rocket propulsion technology efforts performed in PE 0603302F, Projects 4373 and 6340, are transferred into this project, in order to align projects with the Air Force Research Laboratory organization. In FY 2003, only the space unique technology efforts in this project will be transferred to PE 0603500F, Project 5033, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

**(U) A. Mission Description**

This project develops advanced and innovative low-cost rocket turbomachinery and components, low-cost space and missile launch propulsion system technologies, and demonstrates advanced propellants for launch and orbit transfer propulsion. 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. This project also develops chemical, electrical, and solar rocket propulsion system technologies for station keeping and on-orbit maneuvering applications. 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 will improve the performance of expendable systems' payload capabilities by ~20 percent and reduce the launch and operations and support costs by ~30 percent. Technology advances will also lead to seven-year increase in satellite on-orbit time, a 50 percent increase in satellite maneuvering capability, a 25 percent reduction in orbit transfer operational costs, and a 15 percent increase in satellite payload. The projects in this program are part of the Integrated High Payoff Rocket Propulsion Technology (IHRPT) program, a joint Department of Defense, National Aeronautics and Space Administration (NASA), and industry effort to focus rocket propulsion technology on national needs.

Note: In FY 2002, Congress added \$4.4 million for the IHRPT program.

**(U) FY 2001 (\$ in Thousands)**

- (U)** \$0                      Previously accomplished in PE 0603202F, Projects 4373 and 6340.
- (U)** \$0                      Total

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<b>03 - Advanced Technology Development</b>	<b>0603216F Aerospace Propulsion and Power Technology</b>	<b>4922</b>
<b>(U) <u>A. Mission Description Continued</u></b>		
<b>(U) <u>FY 2002 (\$ in Thousands)</u></b>		
<b>(U) \$10,675</b>	Develop propulsion technology for current and future space launch vehicles. Continue to develop turbomachinery components for integration into advanced liquid test bed demonstrator. Complete fabrication and assembly of combustion chamber and injector for liquid engine booster. Continue fabrication of oxygen turbopump for integration into an advanced liquid booster engine. Complete testing of oxygen and hydrogen preburner components for integration into an advanced liquid booster engine. Complete the design of advanced hydrocarbon test bed engine and begin fabrication of hardware.	
<b>(U) \$5,000</b>	Conduct detailed design of hydrocarbon rocket engine test bed to enable responsive, reliable, operable, and affordable access to space. Conduct analyses to determine optimum operating conditions and cooling requirements for hydrocarbon rocket engine. Develop rocket engine test bed component design to include turbopumps, boost pumps, and thrust chambers. Demonstrate use of hydrocarbon fuels and additives to cool engine without causing coking or stability problems.	
<b>(U) \$3,775</b>	Develop propulsion technologies for current and future upper stage and orbit transfer vehicles. Continue to demonstrate solar thermal propulsion technologies, such as strut development, pointing, and tracking, for orbit transfer and maneuvering propulsion. Continue program to develop electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of low-earth orbit-geosynchronous earth orbit transfer.	
<b>(U) \$4,000</b>	Develop technologies for the sustainment of strategic systems. Continue the Post Boost Control System program to demonstrate component technologies with readily available materials to reduce hardware costs, achieve a 90 percent reduction in hydrazine leakage, and five times increase in service life for ballistic missiles. Begin evaluating the Strategic Sustainment Demonstration program hardware that integrates advanced propellant, case, and nozzle technologies.	
<b>(U) \$2,800</b>	Develop electric propulsion technologies for satellite formation flying, station keeping, and repositioning. Continue development of mathematical models to address different propulsion technologies that could be used for small satellite formation flying. Continue brass board level testing of a pulsed plasma thruster. Continue development of propulsion systems for Air Force small satellites (<100 kg) required for key Air Force Space Command concepts. Complete design of flight hardware and begin technology transition of selected propulsion concepts. Complete the fabrication of engine hardware for the TechSat 21 spacecraft.	
<b>(U) \$4,357</b>	Continue to develop turbomachinery components for integration into an advanced liquid propellant test bed demonstration. Complete fabrication and assembly of the combustion chamber and injector for a liquid engine booster. Continue fabrication of oxygen turbopump for integration into an advanced liquid booster engine. Complete testing of oxygen and hydrogen preburner components for integration into an advanced liquid booster engine.	
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BUDGET ACTIVITY		PROJECT
<b>03 - Advanced Technology Development</b>	<b>0603216F Aerospace Propulsion and Power Technology</b>	<b>4922</b>
<p>(U) <b><u>A. Mission Description Continued</u></b></p> <p>(U) <b><u>FY 2002 (\$ in Thousands) Continued</u></b></p> <p>(U) \$30,607 Total</p> <p>(U) <b><u>FY 2003 (\$ in Thousands)</u></b></p> <p>(U) \$1,464 This project previously included space unique funding which has been transferred to PE 0603500F, Project 5033. These funds represent the civilian salaries for the work effort transferred and will be transferred at a later date.</p> <p>(U) \$1,464 Total</p> <p>(U) <b><u>B. Project Change Summary</u></b> Not Applicable.</p> <p>(U) <b><u>C. Other Program Funding Summary (\$ in Thousands)</u></b></p> <p>(U) Related Activities:</p> <p>(U) PE 0602102F, Materials.</p> <p>(U) PE 0602601F, Spacecraft Technology.</p> <p>(U) PE 0603401F, Advanced Spacecraft Technology.</p> <p>(U) PE 0603853F, Evolved Expendable Launch Vehicle Program.</p> <p>(U) PE 0603114N, Power Projection Advanced Technology.</p> <p>(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</p> <p>(U) <b><u>D. Acquisition Strategy</u></b> Not Applicable.</p> <p>(U) <b><u>E. Schedule Profile</u></b></p> <p>(U) Not Applicable.</p>		
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BUDGET ACTIVITY 03 - Advanced Technology Development				PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology				PROJECT 681B		
COST (\$ in Thousands)		FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
681B	Advanced Turbine Engine Gas Generator	35,617	36,480	34,488	29,929	26,755	27,295	27,811	Continuing	TBD
<p>(U) <b>A. Mission Description</b>            This project develops turbine engine gas generator technology for current and future aircraft propulsion systems. The objective is to provide the continued evolution of technologies into an advanced gas generator in which the performance, cost, durability, reparability, and maintainability aspects 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, and a high pressure turbine. 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, and ships. Component technologies are demonstrated in a core (sub-engine) test. Performance is subsequently proven in demonstrator engines under realistic conditions (Project 4921). Efforts are part of the Integrated High Performance Turbine Engine Technology (IHPTET) program. Note: In FY 2002, Congress added \$2 million for vectored thrust ducted propellers.</p>										
<p>(U) <b>FY 2001 (\$ in Thousands)</b></p>										
(U)	\$27,035	Designed, fabricated, and performance tested technology demonstration core engines to provide improved performance and fuel consumption for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports. Completed core engine testing for integrally bladed rotor repair, impingement film floatwall combustor, advanced thermal barrier coating, supercooled high pressure turbine castability, and technologies to mitigate High Cycle Fatigue. Designed and fabricated long-lead hardware for core engine testing of load decoupler fan frame, ceramic matrix composite combustor liner, ceramic bearing, and advanced turbine vane, blade, and disk materials. All of these technologies are applicable to a significant part of the Air Force engine inventory along with future engines.								
(U)	\$1,953	Designed, fabricated, and durability tested technology demonstration core engines to provide increased durability and affordability for turbofan/ turbojet engines for fighters, attack aircraft, bombers, and large transports. Conducted core engine testing of national High Cycle Fatigue program, compressor rotor ring damper, compressor rotor damping coating, and advanced non-intrusive stress measurement system.								
(U)	\$4,181	Designed, fabricated, and tested technology demonstration core engines to provide improved performance and fuel consumption for turboshaft/ turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large uninhabited air vehicles. Conducted core engine testing of splintered compressor rotor, rich quench lean combustor, counter rotating turbines, ceramic turbine vanes, and hybrid ceramic bearings. Fabricated hardware for core engine testing of forward swept splintered compressor rotor, high temperature rise								
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<b>03 - Advanced Technology Development</b>	<b>0603216F Aerospace Propulsion and Power Technology</b>	<b>681B</b>
<b>(U) <u>A. Mission Description Continued</u></b>		
<b>(U) <u>FY 2001 (\$ in Thousands) Continued</u></b>		
	combustor, counter rotating vaneless turbine, ceramic matrix composite turbine blades and vanes, and magnetic bearings.	
<b>(U) \$2,115</b>	Designed, developed, and initiated testing on structures and propulsion designs to demonstrate performance and durability of advanced hypersonic propulsion concepts in support of Defense Advanced Research Projects Agency missile demonstration. Performed fabrication and testing of flight type scramjet combustor and inlet.	
<b>(U) \$333</b>	Evaluated novel vectored thrust propellers for turboprop/turboshaft engine concepts for application to helicopters for combat rescue.	
<b>(U) \$35,617</b>	Total	
<b>(U) <u>FY 2002 (\$ in Thousands)</u></b>		
<b>(U) \$29,080</b>	Design, fabricate, and test performance of technology demonstrator core engines to provide improved performance and fuel consumption for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports. Complete design and continue fabrication of hardware for core engine testing of load decoupler fan frame, ceramic matrix composite combustor liner, ceramic bearing, and advanced turbine vane, blade, and disk materials. Design advanced hardware for core engine testing of a high pressure ratio four stage compressor with stability enhancing control, integrated lightweight combustor with ceramic matrix composite panels, a microplasma ignitor, revolutionary turbine blade material, and an endothermic fuel/air heat exchanger.	
<b>(U) \$2,270</b>	Design, fabricate, and test durability of technology demonstration core engines to provide increased life and affordability for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports. Design turbine engine advanced hardware for core engine evaluation in the national durability program.	
<b>(U) \$3,149</b>	Design, fabricate, and evaluate technology demonstration core engines to provide improved performance and fuel consumption for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large unmanned air vehicles. Continue evaluation of core engine forward swept splintered compressor rotor, high temperature rise combustor, counter rotating vaneless turbine, ceramic matrix composite turbine blades and vanes, and magnetic bearings.	
<b>(U) \$1,981</b>	Develop turboprop/turboshaft engine technologies that are applicable to military helicopter applications such as combat search and rescue.	
<b>(U) \$36,480</b>	Total	
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<b>03 - Advanced Technology Development</b>	<b>0603216F Aerospace Propulsion and Power Technology</b>	<b>681B</b>
<p>(U) <b><u>A. Mission Description Continued</u></b></p> <p>(U) <b><u>FY 2003 (\$ in Thousands)</u></b></p> <p>(U) \$28,826 Design, fabricate, and performance test technology demonstration core engines to provide improved performance and fuel consumption for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports. Complete design and continue hardware fabrication of a core engine test article with a load decoupler fan frame, a trapped vortex combustor, ceramic matrix composite combustor liner, ceramic bearing, advanced turbine blisk and advanced turbine vane materials. Complete design and continue fabrication of hardware for core engine testing of a high pressure ratio four stage compressor with integrated lightweight combustor with ceramic matrix composite panels, microcircuit cooling, revolutionary hot section material, and an endothermic fuel/air heat exchanger. 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.</p> <p>(U) \$2,024 Design, fabricate, and durability test technology demonstration core engines to provide increased durability and affordability for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports. Continue design and initiate fabrication of long lead hardware for turbine engine advanced hardware for core engine evaluation in the national durability programs.</p> <p>(U) \$3,638 Design, fabricate, and evaluate technology demonstration core engines to provide improved performance and fuel consumption for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large uninhabited air vehicles. Complete core engine testing of forward swept splintered compressor rotor, high temperature rise combustor, counter rotating vaneless turbine, ceramic matrix composite turbine blades and vanes, and magnetic bearings.</p> <p>(U) \$34,488 Total</p> <p>(U) <b><u>B. Project Change Summary</u></b> Not Applicable.</p> <p>(U) <b><u>C. Other Program Funding Summary (\$ in Thousands)</u></b></p> <p>(U) Related Activities:</p> <p>(U) PE 0602201F, Aerospace Flight Dynamics.</p> <p>(U) PE 0602203F, Aerospace Propulsion.</p> <p>(U) PE 0602122N, Aircraft Technology.</p> <p>(U) PE 0603210N, Aircraft Propulsion.</p> <p>(U) PE 0603003A, Aviation Advanced Technology.</p> <p>(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</p>		
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<b>03 - Advanced Technology Development</b>	<b>0603216F Aerospace Propulsion and Power Technology</b>	<b>681B</b>
<p>(U) <b><u>D. Acquisition Strategy</u></b> Not Applicable.</p> <p>(U) <b><u>E. Schedule Profile</u></b> (U) Not Applicable.</p>		
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