RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: June 2001

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

	COST ($ in Thousands)	FY 2000 Actual	FY 2001 Estimate	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	76,285	123,618	149,211	136,547	138,807	139,478	143,173	146,919	Continuing	TBD
3012	Advanced Propulsion Technology	0	0	21,585	7,041	7,491	7,801	8,002	8,212	Continuing	TBD
3048	Fuels and Lubrication	11,247	8,735	9,645	14,345	14,402	14,637	15,022	15,416	Continuing	TBD
3066	Turbine Engine Technology	38,979	41,705	41,387	40,405	38,528	35,450	36,418	37,370	Continuing	TBD
3145	Aerospace Power Technology	26,059	28,002	21,583	24,113	24,216	24,512	25,162	25,819	Continuing	TBD
4847	Rocket Propulsion Technology	0	45,176	55,011	50,643	54,170	57,078	58,569	60,102	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: FY 2003-FY 2007 budget numbers do not reflect the DoD strategy review results.

As of FY 2001, all rocket propulsion efforts previously performed in PE 0602601F, Project 1011, Rocket Propulsion Technology, were transferred to Project 4847 in order to align projects with the Air Force Research Laboratory organization.

In FY 2001, efforts formerly in PE 0602269F, Project 1025, Hypersonic Technology Program, were shifted to PE 0602203F, Project 3066; PE 0603202F, Project 668A; and PE 0603216F, Project 681B. In FY 2002, the Hypersonic Technology Program work performed in PE 0602203F, Project 3066; PE 0603202F, Project 668A; and PE 0603216F, Project 681B will be transferred to Project 3012 in order to align projects with the Air Force Research Laboratory organization.

In FY 2001, Congress added $12.6M and $11.1M to PE 0305182F, Spacelift Range System, to activate Rocket Test Stand 1D and upgrade Rocket Component Test Stand 2A, respectively, at Edwards Air Force Base, California. In FY 2001, the funding was realigned to PE 0602203F, project 4847, to align funding with the appropriate PE for this effort. The funding database has not yet been updated to reflect this realignment. Funding for this effort is found in PE 0305182F, Project 4137, Range Standardization and Automation. However, this effort is described in Project 4847.

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(U) A. Mission Description

The Aerospace Propulsion program develops propulsion and power technologies to achieve enabling and revolutionary aerospace technology capabilities. The program has five projects, each focusing on a technology area critical to the Air Force: 1) The Turbine Engine Technology project develops enabling capabilities to enhance performance and affordability of existing weapon systems. Turbine Engine Technology project efforts are part of the Integrated High Performance Turbine Engine Technology (IHPTET) program; 2) The Rocket Propulsion Technology project pursues advances in rocket technologies for space access and maneuver, and tactical and strategic missiles. Rocket Propulsion Technology project efforts are part of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program; 3) The Aerospace Power project develops efficient energy storage and generation techniques for ground, air, and space military applications; 4) The Fuels and Lubrication project develops new concepts and technologies to power, cool, and lubricate new and existing engines; and 5) The Advanced Propulsion Technology project develops combined cycle and advanced airbreathing hypersonic propulsion technologies to enable revolutionary propulsion options for the Air Force. Note: In FY 2001, Congress added $0.8 million for Fuels and Lubricants; $3.8 million for magnetic bearing cooling turbine; $2.6 million for Poly (p-phenylene-2,6-benzobisoxazole) (PBO) Membrane Fuel Cells; $1.8 million for Variable Displacement Vane Pump (VDVP); $3.5 million for Hypersonic Electric Power System; and $1 million for Lithium Ion battery.

(U) B. Budget Activity Justification

This program is in Budget Activity 2, Applied Research.

(U) C. Program Change Summary ($ in Thousands)

		FY 2000	FY 2001	FY 2002	Total Cost
(U)	Previous President's Budget (FY 2001 PBR)	77,007	116,262	127,333	
(U)	Appropriated Value	77,712	124,762		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-38			
	b. Small Business Innovative Research	-1,763			
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram	1,029			
	e. Rescissions	-655	-1,144		
(U)	Adjustments to Budget Years Since FY 2001 PBR			21,878	
(U)	Current Budget Submit/FY 2002 PBR	76,285	123,618	149,211	TBD

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion

(U) C. Program Change Summary ($ in Thousands) Continued

(U) Significant Program Changes:

Note: Changes to this program since the previous Presidents Budget are due to PE realignments to align projects with the Air Force Research Laboratory organization. Fiscal Year 2002 increases are also due to the recent DoD strategy review which increased funding for hypersonic and rocket propulsion technologies to enable fuller dominance of space.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: June 2001

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT: 3012

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3012	Advanced Propulsion Technology	0	0	21,585	7,041	7,491	7,801	8,002	8,212	Continuing	TBD

Note: In FY 2002, the Hypersonic Technology Program work formerly performed in Project 3066; PE 0603202F, Project 668A; and PE 0603216F, Project 681B has been transferred to Project 3012 in order to align projects with the Air Force Research Laboratory organization.

(U) A. Mission Description

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

(U) FY 2000 ($ in Thousands)

(U) $0 This work was performed in PE 0602269F, Project 1025.

(U) $0 Total

(U) FY 2001 ($ in Thousands)

(U) $0 This work is performed in PE 0602203F, Project 3066; PE 0603202F, Project 668A; and PE 0603216F, Project 681B.

(U) $0 Total

(U) FY 2002 ($ in Thousands)

(U) $14,500 Demonstrate advanced hydrocarbon scramjet engine technology to enable fuller dominance of space. Conduct detailed analysis for mating scramjet flight ready engine with flight demonstrator vehicle. Perform trajectory optimization for flight test. Complete design and component development. Initiate fabrication of flight-ready hydrocarbon fueled scramjet engine, including flight weight fuel cooled structures, flight weight fuel control valves, fuel pump, and engine controller. Evaluate options for scramjet start, including gas generator / heat exchanger system, barbotage fuel injection with plasma ignition, and silane injection with a mechanical throat or air throttle. Demonstrate flight weight scramjet start system. Verify operation of engine control techniques, based on rapid shock train identification/characterization coupled with fuel control logic, to ensure stable scramjet operation.

(U) $1,422 Conduct assessments, system design trades, and simulations to integrate combined and advanced cycle airbreathing hypersonic propulsion technologies into future missiles, manned and unmanned air vehicles, and access to space concepts. The goal is to improve warfighting

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion	PROJECT: 3012

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

capability and meet Air Force Global Reach/Power needs. Conduct system trade studies to determine military payoff and establish component technology goals. Define component and engine performance objectives to enable development of affordable hypersonic flight demonstrators jointly with NASA and the Defense Advanced Research Projects Agency (DARPA).

(U) $3,050 Conduct proof-of-concept demonstrations of critical components for advanced and combined cycle engines. Design, fabricate, and test sub-scale inlet/combustor/nozzle to identify coupling between engine operating modes and investigate transition between modes. Design and fabricate components capable of withstanding severe temperature and acoustic environments, and demonstrate component structural integrity. Demonstrate flight-type scramjet engine operation and performance over a broad flight speed envelope.

(U) $2,113 Design flowpath for advanced and combined cycle engines to demonstrate operation and performance over a broad flight speed envelope. Initiate design of advanced and combined cycle engines components for incorporation into advanced and combined cycle demonstrator engines.

(U) $500 Develop plasma ignition system coupled with necessary power source, power conditioning, and control system to eliminate need to pre-heat fuel or use silane combustion aid. Investigate magnetohydrodynamic power generation and extraction from a hydrocarbon fueled scramjet flow path to provide energy for directed energy weapons and plasma generation for hypersonic vehicle drag reduction and scramjet combustion enhancement.

(U) $21,585 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0601102F, Defense Research Sciences.
(U) PE 0602201F, Aerospace Flight Dynamics.
(U) PE 0602602F, Conventional Munitions.
(U) PE 0602702E, Tactical Technology.
(U) PE 0603211F, Aerospace Structures.
(U) PE 0603216F, Aerospace Propulsion and Power Technology.
(U) PE 0603601F, Conventional Weapons Technology.
(U) Program is reported to/coordinated by the Joint Army/Navy/NASA/Air Force (JANNAF) Executive Committee.
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion
PROJECT: 3012	

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: June 2001

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT: 3048

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3048	Fuels and Lubrication	11,247	8,735	9,645	14,345	14,402	14,637	15,022	15,416	Continuing	TBD

(U) A. Mission Description

The Fuels and Lubrication project develops improved fuels, lubricants, and combustion concepts for advanced turbine engines, scramjets, and combined cycle engines. Systems applications include missiles, aircraft, and hypersonic vehicles for space access. Fuels and lubricants for these engines must be thermally stable, cost-effective, and operate over a broad range of conditions. Analytical and experimental areas of emphasis include fuels and fuels logistics; advanced combustion and propulsion concepts; and lubricants, bearings, electromagnetic rotor, and oil-less engine technology. Note: In FY 2001, Congress added $0.8 million for Fuels and Lubricants.

(U) FY 2000 ($ in Thousands)

(U) $4,176 Developed and tested high thermal stability hydrocarbon fuels to provide higher heat capacity and operating temperatures and reduced pollutant emission and signatures for aerospace systems. This technology results in reduced fuel system fouling/coking (reduced maintenance costs); provides cooling for increased heat load generated by avionics, engines, and other vehicle subsystems; enables reduced fuel consumption (supportability); and reduces vehicle pollutant emissions and signatures (reduced environmental impact and minimized vulnerability). Formulated low-cost fuel additives that increased the thermal stability of jet fuel by 225 degrees Fahrenheit and heat sink by five-fold. In addition, formulated low-cost fuel additives that reduced pollutant emissions (particulates) by 50%. Evaluated additives in small-scale laboratory devices.

(U) $3,551 Designed, evaluated, and matured high-performance, low-emissions, robust combustor concepts for advanced airbreathing engines. Matured Trapped Vortex Combustor technology to provide dramatically improved thrust-to-weight, reduced development, production, and maintenance cost, and lower fuel consumption. Transitioned trapped vortex technology to full-annular combustor design. Conducted breadboard pulse detonation engine testing and model development to quantify actual engine performance and military payoffs. Developed and applied advanced laser diagnostics to fundamental flames and advanced military combustors to determine in situ combustor performance.

(U) $3,520 Developed lubrication and systems diagnostics technologies to permit efficient high-speed rotation of turbine engine components. This technology included conventional and advanced lubricants and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication, for advanced engines. Fabricated test rigs for full-scale demonstration of magnetic bearings for Integrated High Performance Turbine Engine Technology (IHPTET) Phase III engines. Continued small prototype diagnostic unit development for engine health monitoring.

(U) $11,247 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion	PROJECT: 3048

(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands)

(U)	$2,361	Develop high thermal stability hydrocarbon fuels to provide higher heat capacity and operating temperatures and reduced pollutant emissions and signatures for aerospace systems. Evaluate a low-cost fuel additive in small-scale laboratory devices and a reduced scale fuel system simulator. This additive could increase JP-8 thermal stability by 225 degrees Fahrenheit and heat sink by five-fold. Evaluate low-cost fuel additives in research scale combustors to reduce pollutant emissions (particulates) by 50% in aircraft engines.
(U)	$2,917	Develop revolutionary combustion concepts for combined cycle engines and pulse detonation engines. Continue development of novel gas turbine combustor designs including inter-turbine burner. Complete optimization of Trapped Vortex Combustor for inclusion in high performance, low emissions gas turbine engine demonstrators. Conduct preliminary design of pulse detonation engine for military applications. Develop and test multi-tube, high frequency, demonstrator pulse detonation engine to enable high-performance, low-cost propulsion. Demonstrate the inter-turbine burner concept at representative engine operating conditions. Demonstrate advanced optical diagnostic techniques for health monitoring and control of advanced military combustors.
(U)	$2,657	Continue development of lubrication and diagnostic systems technologies to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants and mechanical systems such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches. Emphasis is placed on demonstrating full-scale magnetic bearing hardware at engine conditions projected for advanced demonstrator engines. Continue maturation of small prototype diagnostic units for engine health monitoring based on evolving needs of near-term production and demonstrator engines.
(U)	$800	Develop, formulate, and evaluate affordable advanced fuel additives using novel synthesis techniques, computational chemistry, and bench scale rigs to reduce particulate emissions (i.e., smoke and soot) by 70%, and increase JP-8 fuel high temperature stability to 900 degrees Fahrenheit and low temperature properties to -70 degrees Fahrenheit. The focus is on enhancing aircraft survivability and operating envelope, and reducing maintenance costs. Develop novel magnetic bearings and vapor phase lubrication concepts for advanced lubrication subsystems. Formulate models to simulate advanced lubrication system behavior.
(U)	$8,735	Total

(U) FY 2002 ($ in Thousands)

(U)	$1,950	Develop low-cost additive approaches to improve fuel properties needed for manned and unmanned systems. Approaches include flow improving additives for low temperature properties to enable replacement of specialty fuels with JP-8; thermal-oxidative and pyrolytic deposit-reducing additives to increase the temperature limit of JP-8 to 900 degrees Fahrenheit; and particulate reducing additives to reduce soot emissions and infrared signature from propulsion systems. Initiate development of computer model based upon chemical structure-activity relationships for fuel additives design and performance modeling.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 3048

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

(U)	$463	Study low-cost approaches to reduce fuel logistics footprint. Screen candidate technologies for fuel field diagnostic techniques. Define improvements in additive packages to reduce logistics footprint.
(U)	$675	Examine hydrocarbon fuel behavior under conditions encountered in combined and advanced cycle engines for low-cost access to space. Determine fuel ignition and combustion properties deficiencies. Study high energy density fuels for combined cycle engine applications. Perform payoff analyses and configuration trade studies to define, focus, and evaluate research in common fuels for future military air and space vehicles. Develop modeling and simulation capability for thermal management systems for aerospace vehicles.
(U)	$2,741	Develop and evaluate combustor and propulsion concepts for gas turbine, pulse detonation, and combined and advanced cycle engines for manned and unmanned systems. Complete optimization of the trapped vortex combustor for transition to demonstrator engines. Identify combustor designs to reduce emissions from gas turbine engines. Demonstrate a highly-swirled ultra-compact combustor for use as the main combustor of a gas turbine engine. Investigate non-traditional thermodynamic cycles and propulsion systems through modeling, simulation, and experimentation. Perform payoff analyses and configuration trade studies to define, focus, and evaluate propulsion technology research for revolutionary combustor and propulsion concepts. Continue the development of pulse detonation engine technology and evaluate performance using hydrocarbon fuel.
(U)	$288	Develop advanced optical and electromechanical diagnostics techniques and devices for fuel systems. Develop revolutionary combustor and propulsion concepts. Investigate pollutant gaseous emissions and particulate formation mechanisms and mitigation techniques in combusting environments.
(U)	$1,503	Conduct research to provide the Air Force with reliable and economical advanced lubricants. Develop advanced bearing and lubricants concepts, components, and materials for improved engine performance, affordability, and engine health monitoring. Perform payoff analyses and configuration trade studies to define, focus, and evaluate research in lubricants and mechanical systems for combined cycle engines.
(U)	$2,025	Develop advanced bearing concepts for small- and intermediate-sized turbine and rocket engine applications. Develop electromagnetic rotor support and power generation concepts, components, and materials for advanced, oil-less engines.
(U)	$9,645	Total

(U) B. Project Change Summary

Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion
PROJECT: 3048	

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

(U) Related Activities:

(U) PE 0601102F, Defense Research Sciences.

(U) PE 0602805F, Dual Use Science and Technology.

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

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion	PROJECT: 3066

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3066	Turbine Engine Technology	38,979	41,705	41,387	40,405	38,528	35,450	36,418	37,370	Continuing	TBD

Note: In FY 2001, efforts formerly in PE 0602269F, Project 1025, Hypersonic Technology Program, were shifted to PE 0602203F, Project 3066; PE 0603202F, Project 668A; and PE 0603216F, Project 681B. In FY 2002, the Hypersonic Technology Program work will be transferred to PE 0602203F, Project 3012, in order to align projects with the Air Force Research Laboratory organization.

(U) A. Mission Description

The Turbine Engine Technology project develops technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. Analytical and experimental areas of emphasis are fans and compressors, high temperature combustors, turbines, internal flow systems, controls, exhaust systems, and structural design. This project supports the Integrated High Performance Turbine Engine Technology (IHPTET) program, a joint Department of Defense, National Aeronautics and Space Administration (NASA), and industry effort to focus turbine propulsion technology on national needs. The program also supports design activities for the next-generation turbine engine development effort, the Versatile, Affordable, Advanced Turbine Engine (VAATE).

(U) FY 2000 ($ in Thousands)

(U) $27,073 Developed core engine components (compressors, combustors, and high-pressure turbines) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost. Completed fabrication and initiated rig testing of state-of-the-art four-stage compressor through use of three-dimensional aeromechanical blading and endwall contours. Completed fabrication of a high response air valve for active stability control capability for increased stage loading, reduced stage count, and increased stall margin. Completed blade damping model development which includes three-dimensional shroud contact capability among a spectrum of other friction constraints. Tested an advanced high-work turbine yielding heat transfer characterization for reduced cooling flow and increased durability.

(U) $6,600 Developed turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports to provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost. Fabricated exhaust nozzle hardware capable of fluidic injection deleting the requirement for complex, heavy, expensive variable geometry exhaust systems. Fabricated variable displacement vane pump which eliminates fuel recirculation to tanks, thereby reducing thermal loading and allowing increased thermal capacity to be used elsewhere in the weapon system. Completed design of a non-linear control system which simplifies control logic development and provides component performance trend data.

(U) $3,576 Developed components for expendable engines for missile and unmanned air vehicle applications to provide expendable engines with reduced

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(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles.

(U) $1,730 Developed components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports. Fabricated a splittered, forward swept compressor rotor with high efficiency and high stage loadings that reduces fuel consumption and production and maintenance costs with fewer parts. Fabricated prototype high response air valve for active stability control capability for increased stage loading, reduced stage count, and increased stall margin.

(U) $38,979 Total

(U) FY 2001 ($ in Thousands)

(U) $27,315 Develop core engine components (compressors, combustors, and high-pressure turbines) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost. Complete rig testing of a state-of-the-art four-stage compressor and deliver to core engine for complete environmental characterization. Complete compressor rig testing of a high response air valve for active stability control capability for increased stage loading, reduced stage count, and increased stall margin. Develop a reduced order model for intentional mistuning validation and initiate experimental validation. Fabricate the spar/shell turbine blade with enhanced internal convection and limited transpiration cooling technologies and three-dimensional features yielding reduced cooling air at higher design operating temperatures.

(U) $7,021 Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports to provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost. Rig test exhaust nozzle hardware capable of fluidic injection to delete the requirement for complex, heavy, expensive variable geometry exhaust systems. Fabricate contoured ceramic composite exhaust nozzle hardware. Elevate fuel temperature rig testing of the variable displacement vane pump, which eliminates fuel recirculation to tanks, thereby reducing thermal loading and allowing increased thermal capacity to be used elsewhere in the weapon system. Complete design of the non-linear control system, which simplifies control logic development and provides component performance trend data.

(U) $3,814 Develop components for expendable engines for missile and unmanned air vehicle applications to provide expendable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles. Fabricate low-cost ceramic turbine blades yielding reduced need for cooling air and higher performance.

(U) $1,844 Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports. Begin rig testing splittered, forward swept compressor rotor to validate high efficiency, high stage loading design, leading to engines with reduced fuel consumption, fewer parts, and lower production and maintenance.

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

(U) $1,711 Design, develop, and test propulsion components to demonstrate performance and durability of advanced hypersonic propulsion concepts in support of Defense Advanced Research Projects Agency (DARPA) missile demonstration. Continue testing of scramjet engine components (e.g., inlet, combustor, and nozzle) capable of demonstrating positive thrust at Mach 4-8 while withstanding severe internal conditions.

(U) $41,705 Total

(U) FY 2002 ($ in Thousands)

(U) $28,325 Develop core turbine engine components (compressors, combustors, and high-pressure turbines) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components enable aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycles costs. Design and fabricate a high-pressure ratio compressor including an active stability control system for reduced fuel burn, and high reaction blading and engine stall avoidance techniques for reduced maintenance costs. Develop improved performance, reduced emissions combustor technologies. Conduct analytical and experimental evaluations of combustor aerodynamics, fuel-air mixing, and liner cooling techniques. Develop affordable, robust, lightweight, and compact combustors such as the Integrated Lightweight Combustor or Trapped Vortex Combustor configurations. Conduct environmental and structural evaluation of spar/shell turbine blade with enhanced internal convection, limited transpiration cooling technologies, and three-dimensional features to reduce cooling air at high design operating temperatures. Rig test a non-contacting stress measurement system allowing durable measurement of vibratory response of rotating blades. This technology enables replacements for limited life strain gages, reducing core engine components development and maintenance costs.

(U) $6,967 Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components enable aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost. Validate the contoured ceramic composite exhaust nozzle hardware in a high temperature environment. Evaluate temperature, pressure, and vibration of integrated components in a demonstrator engine. Complete reliability testing of variable displacement vane pump system to eliminate fuel recirculation to tanks, reduce thermal loading, and increase weapon system thermal capacity. Complete fabrication of the non-linear control system to simplify control logic development and provide component performance trend data.

(U) $3,784 Develop components for limited life engines for missile and unmanned air vehicle applications. These components enable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles and unmanned vehicles. Rig test a composite forward swept fan for reduced weight, improved efficiency, and lower cost. Rig test low-cost ceramic turbine blades to reduce cooling air and enhance performance.

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BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion	PROJECT: 3066

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

(U)	$2,311	Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports. Complete rig testing the splittered, forward swept compressor rotor to validate high efficiency, high stage loading design. The components enable engines with reduced fuel consumption and lower production and maintenance costs.
(U)	$41,387	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Materials:
(U) PE 0601102F, Defense Research Sciences.
(U) PE 0602102F, Materials.
(U) PE 0603216F, Aerospace Propulsion and Power Technology.
(U) PE 0602122N, Aircraft Technology.
(U) PE 0603210N, Aircraft Propulsion.
(U) PE 0603003A, Aviation Advanced Technology.
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: June 2001

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT: 3145

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3145	Aerospace Power Technology	26,059	28,002	21,583	24,113	24,216	24,512	25,162	25,819	Continuing	TBD

(U) A. Mission Description

The Aerospace Power Technology project develops techniques for efficient energy generation and storage for military ground, air, and space applications. Power component technologies are developed to increase reliability, maintainability, commonality, and supportability of aircraft and flight line equipment. Research in power storage technologies enables the 10-20 year long-term energy storage goals of Air Force unmanned vehicles. Electrical power generation and thermal management technologies are enabling for all future military directed energy weapon systems. This project supports development of very high output power systems suitable for applications to air moving target indication (AMTI) radar, high power lasers for space platforms, and orbiting/maneuvering vehicles. Lightweight power systems suitable for other space applications are also developed. Note: In FY 2001, Congress added $3.8 million for magnetic bearing cooling turbine; $2.6 million for Poly (p-phenylene-2,6-benzobisoxazole) (PBO) Membrane Fuel Cells; $1.8 million for Variable Displacement Vane Pump (VDVP); $3.5 million for Hypersonic Electric Power System; and $1 million for Lithium Ion battery.

(U) FY 2000 ($ in Thousands)

(U) $9,472 Developed power generation, conditioning, and distribution; energy storage; and thermal management component and subsystem technologies for manned and unmanned aircraft systems to improve aircraft self-sufficiency, reliability, maintainability, and supportability while reducing life cycle costs and enabling new capabilities. Designed Inverter Converter Controller (ICC) for starter/generator systems that doubles power density, thus enabling the use of these systems on manned and unmanned aircraft. Developed high energy density lithium ion cell and maintenance-free battery technology to achieve aircraft-level weight savings and meet increasing power demands in limited envelopes.

(U) $6,858 Developed thermal management, energy storage and power conditioning components and subsystem technologies for AMTI radar, space-based laser, and orbiting/maneuvering vehicles. Specifically, developed high energy density polycrystalline capacitors, high voltage/high power diamond switches, and distributed power for laser diodes to enable the use of high power lasers on space platforms. Developed small-scale heat pipes for passive power electronics cooling for improved power density. Designed space mission enabling high energy density lithium ion cells and batteries.

(U) $592 Developed cryogenic power generation, high rate batteries, energy storage and power conditioning components, and system technologies with low volume displacement for delivery of high power for operation of directed energy weapons. Conducted a feasibility study of high temperature superconducting (HTSC) high power generator technology to develop Yttrium Barium Copper Oxide (YBCO) coated conductors. This HTSC technology is enabling for ground mobile, airborne, and space-based directed energy power sources.

(U) $2,921 Developed alternative energy conversion techniques for ground and space applications. These techniques included such technologies as thermal

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(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

photovoltaics and thermionic energy converters, which could either be powered by energy from the sun or traditional combustion techniques.

(U) $6,216 Developed alternative secondary power system related technologies that will help transition more electric technology to current and future aircraft. Specific development efforts focused on air-driven power generation, magnetic bearing coolers, and variable displacement fuel pumps.

(U) $26,059 Total

(U) FY 2001 ($ in Thousands)

(U) $5,730 Develop power generation, conditioning, and distribution; 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. Fabricate Inverter Converter Controller (ICC) to demonstrate power density improvements. Continue development of high energy density lithium ion cell and maintenance free battery technology by testing cells and batteries to load profiles specified in performance requirements for aircraft.

(U) $9,080 Develop thermal management, energy storage, and power conditioning components, and subsystem technologies for air moving target indication (AMTI) radar, high power lasers for space platforms, and orbiting/maneuvering vehicles. Design an integrated Power Management and Distribution (PMAD) for space-based distributed power systems with half the weight and volume of conventional approaches. Continue development of high energy density polycrystalline capacitors, high voltage/high power diamond switches, and distributed power for laser diodes to enable high power lasers on space platforms. Develop small-scale heat pipes for passive power electronics cooling for improved power density. Evaluate cycle life for long-term space applications of high energy density lithium ion cells and batteries.

(U) $492 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 for operation of directed energy weapons. Expand development of Yttrium Barium Copper Oxide (YBCO) coated conductors to include coils for high temperature superconducting high power generator development.

(U) $1,000 Design, fabricate, and evaluate lithium ion cells for battery applications for high power military requirements such as pulse power weapons for space and aircraft, burst communication devices, and on-the-soldier weapons and communications equipment.

(U) $3,800 Continue development of turbomachine incorporating magnetic bearings to provide augmented cooling and electrical power to Air Force systems. Design and fabricate ground test turbomachine equipment for aircraft application. Evaluate feasibility of magnetic bearings to meet directed energy weapon and Expeditionary Air Force ground support power applications.

(U) $2,600 Develop the Poly(p-phenylene-2, 6-benzobisoxazole) (PBO) membrane for use in Proton Exchange Membrane (PEM) direct methanol fuel cells. Characterize physical and electrochemical properties of the membranes. Evaluate the performance of a PBO membrane in a direct methanol fuel cell.

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

(U)	$1,800	Modify the Variable Displacement Vane Pump (VDVP) design for test on an engine with commercial applications. Fabricate a VDVP design for advanced tactical aircraft applications and evaluate initial endurance and damage tolerance.
(U)	$3,500	Conceptualize integrated vehicle-power-generation-weapon system. Simulate and design electrical components for magneto-hydrodynamic (MHD) and electro-magneto-hydrodynamic (EMHD) power systems to provide high power sources for hypersonic systems and directed energy weapons. Enable MHD pressure control of hypersonic engine inlet.
(U)	$28,002	Total

(U) FY 2002 ($ in Thousands)

(U)	$9,763	Develop power generation, conditioning, and distribution; 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. Fabricate and begin evaluation of advanced switched reluctance machine controllers. Continue development of high energy density lithium ion cell and maintenance free battery technology by testing cells and batteries to load profiles requirements for aircraft. Initiate development of lithium polymer cells. Complete design of low-cost, long duration fuel cells for unmanned air vehicle systems. Develop and test magnetic materials for high temperature generator and magnetic bearing aircraft applications.
(U)	$6,261	Develop thermal management, energy storage and power conditioning components, and subsystem technologies for space applications. Fabricate an integrated Power Management and Distribution system for space-based distributed power systems that are half the weight and volume of conventional approaches. Demonstrate radiation-hardened power semiconductor device. Continue development of high energy density polycrystalline capacitors, high voltage/high power diamond switches, and distributed power for laser diodes to enable the use of high power lasers on space platforms. Test cycle life of high energy density lithium ion cells and batteries for long-term space applications. Evaluate mechanical pumped-loop for higher power spacecraft. Continue work on active two-phase thermal management technologies.
(U)	$5,559	Develop cryogenic power generation, high rate batteries, energy storage and power conditioning components, and system technologies with low volume displacement. These technologies enable delivery of high power for operation of directed energy weapons. Complete designing high density power conditioning for directed energy weapon systems. Develop high rate (pulse power) Lithium Ion batteries. Begin development of a thermal management system for cryogenic generator applications.
(U)	$21,583	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0601102F, Defense Research Sciences.

(U) PE 0602102F, Aerospace Flight Dynamics.

(U) PE 0602605F, Directed Energy Technology.

(U) PE 0602805F, Dual Use Science and Technology.

(U) PE 0603205, Flight Vehicle Technology.

(U) PE 0603605F, Advanced Weapon Technology.

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

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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PROJECT: 4847

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4847	Rocket Propulsion Technology	0	45,176	55,011	50,643	54,170	57,078	58,569	60,102	Continuing	TBD

Note: As of FY 2001, all rocket propulsion efforts previously performed in PE 0602601F, Project 1011, Rocket Propulsion Technology, were transferred to Project 4847 in order to align projects with the Air Force Research Laboratory organization.

In FY 2001, Congress added $12.6M and $11.1M to PE 0305182F, Spacelift Range System, to activate Rocket Test Stand 1D and upgrade Rocket Component Test Stand 2A, respectively, at Edwards Air Force Base, California. IN FY 2001, the funding was realigned to PE 0602203F, Project 4847, to align the funding with the appropriate PE for this effort. The funding data base has not yet been updated to reflect this realignment. Funding for this effort is found in PE 0305182F, Project 4137, Range Standardization and Automation. However, the effort is described in Project 4847.

(U) A. Mission Description

The Rocket Propulsion Technology project develops advances in rocket technologies for space access, maneuver, and for tactical and strategic missiles. Analytical and experimental areas of emphasis are propellants, combustion, rocket materials, strategic sustainment, and novel space propulsion concepts. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of future space and missile launch sub-systems. Technologies are developed to reduce the weight and cost of components using new materials, and improved designs and manufacturing techniques. All efforts in this project are part of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program, a joint Department of Defense, National Aeronautics and Space Administration (NASA), and industry effort to focus rocket propulsion technology on national needs.

(U) FY 2000 ($ in Thousands)

(U) $0 Previously accomplished in PE 0602601F, Project 1011.

(U) $0 Total

(U) FY 2001 ($ in Thousands)

(U) $4,426 Develop high-energy density and non-toxic propellants for increased space launch payload capability. Refine production of lab-scale quantities of high-energy density propellants with additives at desired concentrations in preparation for scale-up to maximize future propulsion system performance. Scale-up selected propellants for testing and evaluation. Continue to develop, characterize, and model new and advanced propellants for scale-up and testing. Optimize synthetic routes for polymer binders and fuel formulations with specific impulse (Isp) exceeding that available from current systems. Develop high-energy oxidizer formulations for combustion with high-energy fuels to yield greatly enhanced performance. Continue research in the area of low-cost, non-toxic mono-propellants for current and future launch systems. Characterize, study, and evaluate selected propellants in advanced combustion devices to determine compatibility and performance. Develop and characterize advanced propellants for use in revolutionary launch and spacecraft propulsions systems. Provide technical expertise for the continued use of

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

energetic chemical rocket propellants in existing rocket propulsion systems.

(U) $2,788 Develop advanced liquid engine combustion technology for improved performance while preserving chamber lifetime and reliability needs for engines used in heavy lift space vehicles. Continue to characterize, study/evaluate injector performance with application to combustor chamber/injector compatibility to prevent damage to test and operational combustion devices; continue to support commercially developed injectors using unique Air Force test facilities; complete the development of health monitoring techniques using non-intrusive, real-time, in situ measuring techniques, which will be used to avoid catastrophic failure and destruction of launch assets due to a failing engine component. Develop, analyze, and model advanced combustion devices and injectors that are compatible with new energetic propellants. Develop and evaluate through analysis and modeling advanced/revolutionary propulsion concepts with enhanced performance and reliability.

(U) $5,103 Continue to develop advanced material technology for lightweight components and material property enhancements for use in launch and space systems. Develop advanced ablative components using hybrid polymers for use in current and future launch systems Characterize and develop new high temperature polymers and carbon-carbon materials for use in advanced combustion devices and advanced propulsion systems, for lower weight and increased strength requirements. Develop advanced materials for use with high-energy propellants. Transition advanced high temperature materials to the commercial industry and Air Force systems for reduced system weight/cost and increased performance.

(U) $2,089 Complete the development of analytical tools for prediction of propellant life. Complete and transition to industry the tools and techniques used to determine the age life of strategic systems and other solid rocket motors.

(U) $18,695 Continue to develop propulsion component technology for reliable, safe, and low-cost boost and orbit transfer systems. Continue to develop design and processing techniques for high-strength, low-weight engine and motor components (metals and non-metals). Continue development of advanced lightweight rocket engine nozzle for upper stage and space booster applications. Begin development of a low-cost, high discharge pressure turbopump for advanced cryogenic engines. Continue to develop liquid oxidizer for hybrid propulsion technologies for space boosters and air launched missiles. Continue developing and demonstrating advanced materials for rocket engine components and continue to develop turbomachinery, combustion devices, and propellant management devices for solid and liquid rockets. Continue development of high temperature oxygen rich turbine materials for applications to oxidizer rich turbomachinery. Continue application of advanced Aluminum Metal Matrix Composite Materials to rocket turbomachinery housings and rocket structural hardware. Continue characterizing new refractory combustion materials and devices to apply to liquid-propellant rocket engines with dramatic weight reductions. Verify performance and weight improvements of rapid densification nozzle technology using improved strategic propellants for future ballistic missiles. Continue to demonstrate low-cost, high temperature, non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer components for solid rocket space boosters and missiles. Fabricate and test advanced lightweight rocket engine nozzle for upper stage and space booster applications. Continue characterizing new refractory combustion materials and devices to apply to liquid-propellant rocket engines with dramatic weight reductions.

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

Continue to develop and characterize components applicable to liquid propulsion (cryogenic and storable). Initiate feasibility studies concerning rocket based combined cycle engines.

(U) $6,964 Continue development of missile propulsion technology, aging and surveillance technology, and Post Boost Control Systems (PBCS) for sustainment of current Intercontinental Ballistic Missile (ICBM) fleet. Complete development of compatible case/liner, insulator, and case systems for higher combustion temperature propellants. Complete design and begin fabrication of solid rocket motor test hardware. Initiate a project to develop an advanced lightweight solid rocket motor. Continue development of tools to increase the capability to determine the service life of strategic systems and other solid rocket motors. Complete the development of the advanced Post Boost Control Systems (PBCS). Continue to develop technologies that are readily available over the life of strategic systems, which may also be potentially advantageous to the development of the next generation strategic systems.

(U) $5,111 Continue developing solar electric and solar thermal propulsion technologies for stationkeeping, repositioning, and orbit transfer for large communication satellites and satellite constellations. Continue Hall thruster development efforts to meet Air Force need for orbit transfers using electric propulsion. Continue development of propulsion systems, including pulsed plasma thrusters, for micro satellites (< 25 kg) needed for advanced Air Force imaging missions. Continue developing solar thrusters and concentrators for future orbital transfer vehicles. Perform preliminary characterization of concentrator surface roughness. Fabricate an advanced solar thermal thruster and integrate with an inflatable concentrator. Begin development of an electrically controlled solid propellant.

(U) $0 Upgrade and activate rocket engine test stand to enable system level research and test capabilities for new and existing rocket engines. Upgrade test stand for liquid oxygen/kerosene engine research. Prepare test stand to support Integrated High Payoff Rocket Propulsion Technology (IHPRPT) hydrocarbon boost engine test.

(U) $0 Upgrade and activate rocket component test stand 2A at Edwards Air Force Base, California, to support component level research of advanced rocket propulsion systems. Install high-pressure piping and data acquisition system components.

(U) $45,176 Total

(U) FY 2002 ($ in Thousands)

(U) $5,147 Develop, characterize, and test strained-ring, unsaturated hydrocarbons and energetic, reduced-toxicity monopropellants to increase space launch payload capability. Refine synthesis methods of new propellants to facilitate the transition from producing lab-scale quantities to producing sufficient material to meet operational requirements. Continue scale up of selected propellants for laboratory and demonstrator engine evaluations. Develop high-energy-density oxidizers and polymeric binders (i.e., linked heterocyclic compounds), and optimize paths for incorporating these materials into propellants with significantly enhanced performance. Continue evaluating the potential of monopropellants

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

comprised of reduced-toxicity ionic salts to reduce the cost of space access and space operations. The goal is monopropellants with performance equivalent to bipropellants. Continue to evaluate selected propellants in advanced combustion devices to determine materials compatibility and performance.

(U) $2,514 Develop advanced liquid engine combustion technology to improve performance while preserving chamber lifetime and reliability in heavy lift space vehicle engines. Continue to characterize, study, and evaluate injector performance to ensure chamber/injector compatibility and prevent damage to test and operational combustion devices. Complete the development of rocket motor health monitoring techniques using non-intrusive, real-time, in situ measurements techniques, which will be used to avoid catastrophic failure and destruction of launch assets due to a failing engine component. Continue to develop, analyze, and model advanced combustion devices and injectors compatible with new energetic propellants. Continue to model and analyze advanced propulsion concepts with enhanced performance and reliability such as laser-propelled lightcraft and rocket-based combined cycle engines.

(U) $3,036 Develop advanced technologies and material property enhancements for lightweight components for use in launch and space systems. Develop advanced ablative components using hybrid polymers for use in current and future launch systems Continue to characterize and develop new high temperature polymers and carbon-carbon materials for use in advanced combustion devices and propulsion systems to meet lower weight and increased strength requirements. Continue to develop advanced materials for use with high-energy propellants. Complete and transition advanced high temperature materials to Air Force systems to reduce system weight and cost, and increase performance.

(U) $12,753 Develop propulsion component technology for reliable, safe, and low-cost boost and orbit transfer systems. Complete development of advanced lightweight rocket engine nozzle for upper stage and space booster applications. Continue development of a low-cost, high discharge pressure turbopump for advanced cryogenic engines. Develop components for hybrid propulsion for space boosters and air-launched missiles. Continue to develop turbomachinery, combustion, and propellant management devices for solid and liquid rockets. Continue developing high temperature turbine materials for oxidizer rich applications. Continue developing advanced lightweight rocket engine nozzles for upper stage and space booster applications. Verify performance and weight improvements of rapid densification nozzle technology using improved strategic propellants for future ballistic missiles. Continue to demonstrate low-cost, high temperature, non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer components for solid rocket motors. Develop new fuels and oxidizers for advanced solid propulsion.

(U) $7,088 Develop missile propulsion technology, aging and surveillance technology, and Post Boost Control Systems for sustainment of current Intercontinental Ballistic Missile fleet. Continue to develop an advanced lightweight solid rocket motor. Complete development of tools to enhance the capability to determine the service life of strategic systems and other solid rocket motors. Begin full-scale testing of the advanced Post Boost Control Systems. Complete efforts for prediction of solid motor life and transition into damage assessment models.

(U) $7,423 Develop solar electric and thermal propulsion technologies for stationkeeping, repositioning, and orbit transfer for large communication satellites

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

and satellite constellations. Continue Hall thruster development efforts to achieve Air Force orbit transfers using electric propulsion. Continue development of micro satellites (< 25 kg) propulsion systems (e.g., plasma thrusters) for advanced imaging missions. Continue developing solar thrusters and concentrators for future orbital transfer vehicles. Evaluate electrically controlled solid propellant. Design high power solar thermal components

(U) $12,050 Develop materials and processes to dramatically improve performance, durability, and cost of rocket propulsion systems. Evaluate new candidate materials for rocket engines such as Metal Matrix Composites, Discontinually Reinforced Materials, Ceramics, Ceramic Metallics, and Advanced Composites for use in liquid oxygen, liquid hydrogen, high-temperature, and high-pressure environments. Identify and evaluate the applications of these materials to turbopump housings, ducts, valves, solid rocket casings, insulation, and nozzle throats. Develop material property databases and initiate demonstration of suitability for application using representative geometry and processing conditions for the intended rocket engine components.

(U) $5,000 Develop rocket component of a hydrocarbon fueled rocket based combined/combination cycle engine for rapid acess to space. Initiate studies to establish optimum propulsion cycle and operating conditions. Initiate detailed design of high pressure turbopumps for hydrocarbon propellants. Initiate hydrocarbon thrust chamber design, focusing on affordable, lightweight materials and propellants to provide optimal heat transfer. Evaluate rocket engine health management and prognostic systems. Initiate scale-up and testing of new high density strained-ring hydrocarbon propellants. Evaluate combustion and thermal stability properties of select new hydrocarbon propellants. Produce sufficient quantities of propellants for 100-200 lb thrust level rocket engine demonstrations.

(U) $55,011 Total

(U) B. Project Change Summary

Not applicable.

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

(U) Related Activities:

(U) PE 0601102F, Defense Research Sciences.

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

(U) PE 0602303A, Missile Technology.

(U) PE 0602805F, Dual Use Science and Technology.

(U) PE 0603302F, Space and Missile Launch Technology.

(U) PE 0603311F, Ballistic Missile Technology.

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

(U) PE 0603401F, Advanced Spacecraft Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.