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

DATE: June 2001

BUDGET ACTIVITY: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603302F Space and Missile Rocket 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	16,097	27,776	0	0	0	0	0	0	Continuing	TBD
4373	Launch and Orbit Transfer Propulsion Technology	14,391	22,924	0	0	0	0	0	0	Continuing	TBD
6339	Tactical Propulsion Technology	278	0	0	0	0	0	0	0	Continuing	TBD
6340	Satellite Control and Maneuvering Propulsion Technology	1,428	4,852	0	0	0	0	0	0	0	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	Continuing	TBD

Note: In FY 2000, strategic sustainment efforts have been consolidated in Project 4373; this involved moving the Post-Boost Control and Non-Destructive Evaluation efforts and associated funding from Project 6340 to Project 4373. In FY 2000, the electric propulsion efforts, originally in Project 4373, have been moved to Project 6340. Efforts in Project 6339 will be terminated at the end of FY 2000. In FY 2000, solar thermal efforts have been moved from Project 6340 to Project 4373. Finally, in FY 2002, Projects 4373 and 6340 will transfer to PE 0603216F, Project 4922, in order to align projects with the Air Force Research Laboratory organization.

(U) A. Mission Description

The Space and Missile Roket Propulsion program develops and demonstrates advanced rocket propulsion and space launch technologies. It provides the technological step necessary to transition the most promising rocket propulsion and space launch technologies to applications using full-scale, proof-of-principle demonstrations. The projects within this program are structured to support Air Force Space Command's and Air Combat Command's mission area requirements for space and missile technologies which include the goals established in the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program, a multi-agency/industry effort to focus the development of U.S. rocket propulsion technology. New and improved components will be integrated with the environmentally improved propellants developed in this program to create new propulsion systems for the next generation of launch vehicles and satellites. Anticipated technological advances in this program will improve the performance of expendable systems' payload capabilities by 21 percent and reduce the launch and operations and support (O&S) costs by 28 percent. In a reusable launch system, the anticipated improvements are an increase in payload capability of 170 percent and a reduction in launch and O&S costs of 79 percent. The advances in propulsion in this program result from the achievement of the 2010 goals of the IHPRPT program. The development of these technologies has been coordinated with National Aeronautics and Space Administration (NASA) to eliminate duplication of efforts. The space launch and missile propulsion industry will leverage the technologies from this program to enhance the country's industrial competitiveness. Note: In FY 2001, Congress added $3.75 million for Pulse Detonation

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(U) A. Mission Description Continued

Engine.

(U) B. Budget Activity Justification

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.

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

		FY 2000	FY 2001	FY 2002	Total Cost
(U)	Previous President's Budget (FY 2001 PBR)	16,526	24,283	21,382	
(U)	Appropriated Value	16,731	28,033		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-6			
	b. Small Business Innovative Research	-394			
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram	-61			
	e. Rescissions	-173	-257		
(U)	Adjustments to Budget Years Since FY 2001 PBR			-21,382	
(U)	Current Budget Submit/FY 2002 PBR	16,097	27,776	0	TBD

(U) Significant Program Changes:

In FY 2002, remaining efforts in this PE will transfer to PE 0603216F, Project 634922.

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DATE: June 2001

BUDGET ACTIVITY: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603302F Space and Missile Rocket Propulsion

PROJECT: 4373

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
4373	Launch and Orbit Transfer Propulsion Technology	14,391	22,924	0	0	0	0	0	0	Continuing	TBD

Note: In FY 2002, all rocket propulsion technology efforts performed in Project 4373 are transferred to PE 0603216F, Project 4922, in order to align projects with the Air Force Research Laboratory organization.

(U) A. Mission Description

This project develops advanced and innovative, low-cost rocket turbomachinery and components, low-cost space and missile launch propulsion system manufacturing technologies, and advanced propellants. Characteristics such as environmental acceptability, affordability, reliability, reduced weight, reduced operation and launch costs, and increased life and performance of propulsion systems are emphasized in this project. Technological advances developed in this program will improve the performance of expendable systems' payload capabilities by 21% and reduce the launch and operations and support (O&S) costs by 28%. The advances in propulsion in this program will result from the achievement of the 2010 goals of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program.

(U) FY 2000 ($ in Thousands)

(U) $1,816 Developed propulsion technologies for existing and future launch vehicles. Continued to develop turbomachinery components for integration into advanced liquid test bed demonstrator. Initiated fabrication and assembly of combustion chamber and injector. Continued fabrication of oxygen turbopump for integration into an advanced liquid booster engine. Initiated testing of oxygen and hydrogen turbopump assemblies and preburner components for integration into an advanced liquid booster engine. These demonstrated turbomachinery technologies will significantly reduce the life cycle cost of future expendable and reusable liquid rocket engines.

(U) $3,611 Developed propulsion technologies for existing and future upper stage and orbit transfer vehicles. Continued integration of turbopump and chamber into high-pressure cryogenic upper stage test bed engine. Demonstrated these components in engine level tests. Demonstrated the Phase I goals of increased thrust to weight of 30 percent, decreased hardware/support costs by 15 percent, and increased reliability by 25 percent for the 50k lbs. thrust expander cycle upper stage cryogenic engine. Advanced upper stage engine technology will create significant payload increases for future launch vehicles. Demonstrated solar thermal propulsion technologies on ground tests for orbit transfer and maneuvering propulsion technology.

(U) $1,656 Developed technologies for the sustainment of strategic systems. Continued development of a multi-use, non-detonable (Class 1.3) solid propellant which meets all Intercontinental Ballistic Missile (ICBM) requirements, reduces hardware costs by 25 percent, and maintains current performance levels. Initiated the Strategic Sustainment Demonstration program which integrates advanced propellant, case, and nozzle technologies and demonstrates all cost and performance goals. Continued developing non-destructive evaluation (NDE) technology for large solid rocket motors (SRMs).

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BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion
PROJECT 4373	

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

(U) $1,949 Developed propulsion technologies for future orbit transfer vehicles (OTVs). Completed high performance Hall thruster propulsion technologies for orbit transfer and maneuvering propulsion technology. Completed component tests, integration of components, and scheduled ground demonstration of flight qualified high performance Hall thruster system. Analyzed flight data and correlated with ground test data to complete final report on the 30kW ammonia arcjet thruster.

(U) $5,359 Continued developing propulsion technologies to support the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program. Completed the fabrication of the oxygen turbopump for integration into an advance liquid booster engine. Completed the Phase 1 Solid Boost Demo program which develops propulsion technologies for the next generation of space boosters.

(U) $14,391 Total

(U) FY 2001 ($ in Thousands)

(U) $6,477 Develop propulsion technology for existing and future launch vehicles. Continue to develop turbomachinery components for integration into advanced liquid test bed demonstrator. Continue fabrication and assembly of combustion chamber and injector. Continue fabrication of oxygen turbopump for integration into an advanced liquid booster engine. Continue testing of oxygen and hydrogen turbopump assemblies and preburner components for integration into an advanced liquid booster engine. Install oxygen turbopump assembly into test facility and prepare for hot fire testing of pump assembly. Complete fabrication of oxygen and hydrogen preburner components for integration into an advanced liquid booster engine. Begin the design of advanced hydrocarbon test bed engine.

(U) $8,746 Develop propulsion technologies for existing and future upperstage and orbit transfer vehicles. Complete integration of turbopump and chamber into high-pressure cryogenic upper stage test bed engine. Complete demonstration of these components in engine level tests. Continue to demonstrate solar thermal propulsion technologies, such as strut development and pointing and tracking, for orbit transfer and maneuvering propulsion technology. Continue program to develop electric propulsion systems for orbit transfer by developing high-power Hall thrusters capable of low earth orbit-geosynchronous orbit transfer. Initiate the design of the advanced smallsat propulsion demonstration to develop microsat formation flying for Air Force imaging missions.

(U) $3,967 Develop technologies for the sustainment of strategic systems. Initiate the post boost control system (PBCS) program to demonstrate component technologies with readily available materials to reduce hardware costs, a 90 percent reduction in hydrazine leakage, and a five times increase in service life for liquid fuels ballistic missiles. Continue the Strategic Sustainment Demonstration program which integrates advanced propellant, case, and nozzle technologies and demonstrates all cost and performance goals.

(U) $3,734 Develop technologies for Pulse Detonation Engines (PDE) to enable next generation propulsion options for affordable access to space and unmanned missions. Define PDE performance requirements. Design PDE engine and key subsystems including inlet, intake valve, fuel

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BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion
PROJECT 4373	

(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

injection, initiation, control, and thrust tube. Fabricate components and evaluate fuel injection, initiation, and cooling systems.

(U) $22,924 Total

(U) FY 2002 ($ in Thousands)

(U) $0 Effort moved to PE 0603216F, Project 4922.

(U) $0 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602203F, Aerospace Propulsion.

(U) PE 0602601F, Spacecraft Technology.

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

(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: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603302F Space and Missile Rocket Propulsion

PROJECT: 6339

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
6339 Tactical Propulsion Technology	278	0	0	0	0	0	0	0	0	TBD

Note: Efforts in Project 6339 will be terminated at the end of FY 2000.

(U) A. Mission Description

This project develops highly energetic propellants and propulsion systems. Improved case, insulation, and propellant interfaces as well as better performing nozzles will be developed. Technology such as thrust vector control, thrust modulation, signature characterization, and signature reduction will be developed in this project. The emphasis in this project is on rocket propulsion system affordability and weight reduction. Anticipated payoffs from these developments, identified through the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program, include a 49 percent range increase, 50 percent size reduction, 100 percent payload increase, and 21 percent reduction in time-to-target.

(U) FY 2000 ($ in Thousands)

(U) $278 Developed tactical missile technologies. Integrated component technologies and advanced tactical missile propellants that improve missile thrust and reduce plume exhaust signatures. Manufactured European test motors and selected propellant samples incorporating an advanced high performance, acceptable hazards, low environmental impact, and reduced signature propellant. Shipped these rocket test motors to our European partners (France, Germany, and the United Kingdom) and participated in their evaluations of performance, signature, hazards, mechanical, and aging properties.

(U) $278 Total

(U) FY 2001 ($ in Thousands)

(U) $0 No Activity

(U) $0 Total

(U) FY 2002 ($ in Thousands)

(U) $0 No Activity

(U) $0 Total

(U) B. Project Change Summary

Not Applicable.

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BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion
PROJECT 6339	

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

(U) Related Activities:

(U) PE 0602601F, Spacecraft Technology.

(U) PE 0602303A, Missile Technology.

(U) PE 0603313A, Missile and Rocket Advanced Technology.

(U) PE 0603792N, Advanced Technology Transition.

(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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DATE: June 2001

BUDGET ACTIVITY: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603302F Space and Missile Rocket Propulsion

PROJECT: 6340

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
6340	Satellite Control and Maneuvering Propulsion Technology	1,428	4,852	0	0	0	0	0	0	Continuing	TBD

Note: In FY 2002, all rocket propulsion technology efforts performed in Project 6340 are transferred to PE 0603216F, Project 4922, in order to align projects with the Air Force Research Laboratory organization.

(U) A. Mission Description

Chemical, electric, and solar rocket propulsion system technologies for station keeping and on-orbit maneuvering applications are developed in this project. 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 chemical propellants. The payoffs for the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program include a 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.

(U) FY 2000 ($ in Thousands)

(U) $262 Developed propulsion systems for satellite formation flying. Completed design of pulsed plasma thruster (PPT) for use in satellite formation flying. Completed data analysis of the Electric Space Experiment (ESEX) space flight.

(U) $194 Developed propulsion for satellite stationkeeping and repositioning. Initiated fabrication of brass board test hardware of the pulsed plasma thruster. Completed fabrication of power conditioning systems for ground testing of complete PPT system.

(U) $972 Continued to test propulsion systems for use in satellite propulsion. Began integration of flight hardware onto the TechSat 21 satellite.

(U) $1,428 Total

(U) FY 2001 ($ in Thousands)

(U) $530 Develop propulsion systems for satellite formation flying. Begin development of mathematical models to address different propulsion technologies that could be used for small satellite formation flying. Using these models, downselect the optimum propulsion system for use in small satellites.

(U) $410 Develop propulsion for satellite stationkeeping and repositioning. Initiate brass board level testing of a pulsed plasma thruster system. Hot fire test the thruster in conjunction with the power processing unit.

(U) $3,912 Develop propulsion systems for use in satellite propulsion. Initiate development of propulsion system for fleet of Air Force small satellites (<100 kg) required for key Air Force Space Command concepts. Initiate design of flight hardware and begin technology transition of selected propulsion concepts from the laboratory to the commercial sector. Initiate the fabrication of flight hardware for TechSat 21 spacecraft.

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
03 - Advanced Technology Development	0603302F Space and Missile Rocket Propulsion	6340

(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued
(U) $4,852 Total

(U) FY 2002 ($ in Thousands)
(U) $0 Effort moved to PE 0603216F, Project 4922.
(U) $0 Total

(U) B. Project Change Summary
Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)
(U) Related Activities:
(U) PE 0602203F, Aerospace Propulsion.
(U) PE 0602601F, 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.