PE NUMBER: 0603500F PE TITLE: MULTI-DISCIPLINARY ADV DEV SPACE TEC

	Exhib	DATE	February	2004						
BUDGE ⁻ 03 Adv	r activity vanced Technology Development (/	P 0	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC							
	Cost (\$ in Millions)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	Cost to	Total
	Cost (\$ III MIIIIOIIS)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
	Total Program Element (PE) Cost	51.688	62.077	51.114	59.564	76.337	81.755	73.055	Continuing	TBD
5031	Advanced Optics & Laser Space Tech	14.012	19.437	19.158	22.755	25.303	26.800	27.814	Continuing	TBD
5032	Advanced Space Materials	6.381	11.615	0.000	0.000	5.813	5.316	3.909	Continuing	TBD
5033	Rocket Propulsion Demonstration	24.369	22.032	22.437	28.155	30.710	32.714	33.239	Continuing	TBD
5034	Advanced Space Sensors	4.511	6.018	9.519	8.654	11.605	16.055	7.633	Continuing	TBD
5062	Advanced Structures for Space Vehicles	2.415	2.975	0.000	0.000	2.906	0.870	0.460	Continuing	TBD

Note: In FY 2003 this was a new PE, but not a New Start, resulting from the Space Commission recommendation to consolidate all space unique activities. In FY 2003, only the space unique tasks in the following PEs/Projects transferred to this PE in conjunction with the Space Commission recommendation: PE 0603605F, Projects 3150 and 3647, to Project 5031; PE 0603112F, Projects 2100 and 3946, to Project 5032; PE 0603216F, Project 4922, to Project 5033; and PE 0603203F, Project 665A/PE 0603270F, Projects 431G and 691X, to Project 5034. In FY 2004, efforts in Project 5062, will be complete until FY 2007 when efforts will commence to define spacelift vehicles using the results of the hypersonic engine studies in PE 0602500F, Multi-Disciplinary Space Technology, Project 5027.

(U) <u>A. Mission Description and Budget Item Justification</u>

This program develops and demonstrates multi-disciplinary space technologies in five projects, each focusing on a separate technology area. 1) Advanced optics and laser space technology demonstrates and assesses space unique advanced optics and high energy laser weapon systems capabilities. 2) Advanced space materials develop and demonstrate materials and processing technologies for future space vehicle components and protection of space sensors from a variety of laser threats. 3) Rocket propulsion develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques for launch and spacecraft applications. 4) Advanced space sensors develops and demonstrates sensor technologies for intelligence, surveillance, and reconnaissance, communications, targeting, and electronic counter-countermeasures for spacecraft applications. 5) Advanced structures for space vehicles develop space unique requirements of a horizontal launched Transatmospheric vehicle operating in an extreme environment.

R-1 Shopping List - Item No. 27-1 of 27-18

	Exhibit R-2, RDT&E Buc	Exhibit R-2, RDT&E Budget Item Justification						
BUD(03 A	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINAR	Y ADV DEV S	SPACE TEC				
(U)	B. Program Change Summary (\$ in Millions)							
		<u>FY 2</u>	2003	<u>FY 2004</u>	<u>FY 2005</u>			
(U)	Previous President's Budget	54.	161	62.610	55.814			
(U)	Current PBR/President's Budget	51	688	62.077	51.114			
(U)	Total Adjustments	-2.	473	-0.533				
(U)	Congressional Program Reductions							
	Congressional Rescissions			-0.533				
	Congressional Increases							
	Reprogrammings	-0.	160					
	SBIR/STTR Transfer	-2.	313					
(U)	Significant Program Changes:							
	This is a new PE, but not a New Start, resulting from the Space Con	nmission recommendation to consolidate all space unio	que activities.					
1								
1								
1								

R-1 Shopping List - Item No. 27-2 of 27-18

	Exh	nibit R-2a, F	RDT&E Pro	oject Justi	ification			DATE	February	2004
BUDG 03 Ac	ET ACTIVITY Ivanced Technology Development (/	ATD)			PE NUMBER AND 0603500F MUL DEV SPACE T	TITLE _TI-DISCIPLI EC	NARY ADV	PROJECT NUM 5031 Advand Tech	BER AND TITLE ced Optics &	Laser Space
	Cost ([¢] in Millions)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	Cost to	Total
	Cost (\$ III MIIIIOIIS)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
5031	Advanced Optics & Laser Space Tech	14.012	19.437	19.15	8 22.755	25.303	26.800	27.814	Continuing	TBD
	Quantity of RDT&E Articles	0	0	(0 0	0	0	0		
(U) (U) (U) <u>I</u> (U) <u>I</u> (U) <u>I</u>	 A. Mission Description and Budget Iten This project demonstrates and conducts de B. Accomplishments/Planned Program (S MAJOR THRUST: Perform directed energy pace control and space situational awarenee n FY 2003: Provided data to U.S. Space C 	n Justification etailed assessme fin Millions) gy and space en ess requirement Command for th	ent of space un vironment asse s. e performance	ique technolo essments on s of Laser Cle	ogies needed for a atellites in suppor aringhouse functi	dvanced optica rt of national ons. Fused	al systems and	high-energy la <u>7 2003</u> 0.019	ser weapons. <u>FY 2004</u> 0.000	<u>FY 2005</u> 0.000
I (U) I (U) I (U) (U) N	Inite state models with other satellite data a icture. n FY 2004: Not Applicable. n FY 2005: Not Applicable. AJOR THRUST: Develop and demonstr	and observable:	ong-range rela	more complet y mirror optic	cal technologies s	at awareness uch as		1.228	5.172	3.670
2 (U) I T (U) I (U) I \$ \$ \$	dvanced adaptive optics, beam control, lar ontrol, spacecraft and optical control integ n FY 2003: Developed system concepts an nirrors to advance global strike, global pre Quantified the performance of a membrane pace membrane mirror experiment. Devel n FY 2004: Develop laser relay mirror con lobal presence, and ballistic missile defense imulation tools for relay mirrors.	ge lightweight gration, beam st nd design techn sence, and balli mirror coated loped modeling ncepts and desi se capabilities f	optics, optical abilization, and ology demonst stic missile det with a high-ene and simulation gn technology or the warfight	coatings, thro I jitter contro trations of las fense capabili ergy laser die n tools for spa demonstratio ter. Further d	bughput, dual line l. ser relay mirrors a ities for the warfi lectric coating and ace-based relay m ns to advance glo levelop modeling	e of sight and membrane ghter. d designed a airrors. abal strike, and				
(U) I s (U) (U)	n FY 2005: Developing critical optical tec ystem for developmental and field tests an ltra-light mirror space demonstration expe	chnologies. Into d ultimately an criment.	egrate mature t airborne risk r	echnologies of eduction dem	onto an airborne r nonstration. Com	elay mirror plete design of		7 926	4 229	4 618
(0) 1		ompensation/0		perments for		-		1.720	+.227	+.010
Proje	ct 5031		R-1 Sh	opping List - Ite	em No. 27-3 of 27-1	8			Exhibit R-2a (PE 0603500F)

Exhibit R-2a, RDT&E Project Justification		DATE February	2004
BUDGET ACTIVITY PE NUMBER AND TITL 03 Advanced Technology Development (ATD) 0603500F MULTI-I DEV SPACE TEC	E PROJEC DISCIPLINARY ADV 5031 A Tech	T NUMBER AND TITLE	Laser Space
 antisatellite weapons, relay mirror systems, satellite tests and diagnostics, and high-resolution satellite imag (U) In FY 2003: Performed beam pointing and guidestar radiometry (for atmospheric compensation) tests using sodium-wavelength laser beacon. Designed and began integration of full aperture point-ahead atmospheric compensation system for low-power laser projection to satellites on weapons-class beam director (3.5 meter telescope). Demonstrated high-accuracy active satellite tracking on 3.5 meter telescope with simultaneous compensated satellite imaging and compensated laser projection to a low-earth-orbit satellite (integrated beam demonstration). (U) In FY 2004: Complete integration and begin testing of full aperture point-ahead atmospheric compensation for low-power laser projection to satellites on weapons-class beam director (3.5-meter telescope). (U) In FY 2005: Complete integration and testing of sodium-beacon adaptive optics system including compensation infrared imaging of low earth orbit satellites. Integrate hybrid-beacon full aperture point-ahead atmospheric compensation system on 3.5-meter telescope. 	ing. g a r am control system ated		
 (U) (U) MAJOR THRUST: Develop and demonstrate optical technologies for high bandwidth ground-to-air comm (U) In FY 2003: Not Applicable. (U) In FY 2004: Develop advanced modular deformable mirrors and adaptive optical control systems. Develop optical filters, infrared sensors, and signal processing systems. Begin design of communications breadboard automated ground stations. (U) In FY 2005: Develop and build advanced modular deformable mirrors and adaptive optical control systems advanced optical filters, infrared sensors, and signal processing systems. Develop a portable enclosure system advanced optical filters, infrared sensors, and signal processing systems. Develop a portable enclosure system advanced optical filters, infrared sensors, and signal processing systems. Develop a portable enclosure system advanced optical filters, infrared sensors, and signal processing systems. Develop a portable enclosure system advanced optical filters, infrared sensors, and signal processing systems. Develop a portable enclosure system advanced optical filters, infrared sensors, and signal processing systems. Develop a portable enclosure system advanced optical filters, infrared sensors, and signal processing systems. Develop a portable enclosure system advanced optical filters. 	unications. 0.000 o advanced d for s. Develop em for	10.036	10.870
 (U) (U) CONGRESSIONAL ADD: Aerospace Relay Mirror System. (U) In FY 2003: Developed technologies for an aerospace (airborne) relay mirror testbed. Developed and enha techniques for dual line of sight control via a coude path and two separate telescopes. Developed, matured, integrated beam control, optical, and platform hardware to provide risk reduction for a full-scale relay mirror Developed a point design for the optical system and control system, and integrated with all subsystems. Ta integrated point-ahead beacon technology into the testbed. (U) In FY 2004: Not Applicable. 	4.839 and or system. ilored and	0.000	0.000
(U) In FY 2005: Not Applicable.(U) Total Cost	14.012	19.437	19.158
Project 5031 R-1 Shopping List - Item No. 27-4 of 27-18		Exhibit R-2a	(PE 0603500F)

			za, RDIQE	Project Ju	stification				February	2004
BUD(03 A	GET ACTIVITY Advanced Technology Developi	ment (ATD)			PE NUMBER A 0603500F M DEV SPACE	ND TITLE I ULTI-DISCIPL E TEC	INARY ADV	PROJECT N 5031 Adva Tech	UMBER AND TITLE	Laser Space
03 A (U) (U) (U) (U) (U) (U)	Advanced Technology Develops C. Other Program Funding Summ PE 0602500F, Multi-Disciplinary Space Technology. PE 0602605F, Directed Energy Technology. PE 0603444F, Maui Space Surveillance System. PE 0603605F, Advanced Weapons Technology. PE 0603883C, Ballistic Missile Defense Boost Phase Segment. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.	ment (ATD) nary (\$ in Millio FY 2003 Actual	ons) FY 2004 Estimate	FY 2005 Estimate	ENOMBER A 0603500F M DEV SPACE Estimate	ESTIMATE FY 2007 Estimate	INARY ADV <u>FY 2008</u> <u>Estimate</u>	FY 2009 Estimat	<u>AND TITLE</u> anced Optics & <u>Original Cost to</u> <u>e Complete</u>	Laser Space

	Exi	hibit R-2a, I	RDT&E Pro	oject Justif	ication			DATE	February	2004
BUDO 03 A	GET ACTIVITY dvanced Technology Development ((ATD)		F C E	PE NUMBER AND 0603500F MUI DEV SPACE T	TITLE LTI-DISCIPLI EC	NARY ADV	PROJECT NUME 5032 Advanc	BER AND TITLE	terials
	Cost (\$ in Millions)	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to	Total
5032	2 Advanced Space Materials	6.381	11.615	0.000	0.000	5.813	5.316	3.909	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
conse (U)	 Ote: In F1 2005, space unique tasks in PE 0605112F, Projects 2100 and 3946, were transferred into this project in conjunction with the Space Commission recommendation to onsolidate all space unique activities. In FY 2005, efforts in this project will be delayed until FY 2007 due to higher Air Force priorities. (J) <u>A. Mission Description and Budget Item Justification</u> This project develops and demonstrates materials and processing technologies for transition into Air Force space systems. Materials and processes development is scaled up to the appropriate level to demonstrate materials capability in the relative environment. Subscale components and nonstructural material components are developed and demonstrated to validate expected materials characteristics. Critical data on both structural and nonstructural materials is developed and provided for engineering and system design decisions. Laser hardened materials technologies are developed, demonstrated, and transitioned for the broadband protection of space sensors from a variety 									
(U)	of laser threats. Reducing risk in materia. systems. B. Accomplishments/Planned Program (ls technology in	nproves the aff	ordability, relia	ability, survivab	ility, and opera	ational perform FY	ance of current	FY 2004	ce FY 2005
(U) (U) (U) (U) (U) (U) (U)	MAJOR THRUST: Develop and demonst subsystems to provide enhanced surveillan affordability of space vehicles. In FY 2003: Completed the demonstration performance, and producible infrared detect processing technologies to improve affordat exposure on advanced material systems. In FY 2004: Not Applicable. In FY 2005: Not Applicable. MAJOR THRUST: Develop and demonst Force spacecraft sensors to ensure safety, s In FY 2003: Identified and evaluated optic	rate advanced n ice capabilities, n of improved m ctor materials. T ability of spaced rate advanced n survivability, an cal limiter mater	naterials and pr improved acce naterial process Validated and c craft componen naterials techno d operability in rials for the pro-	rocessing techn ess to space, and ess with increas demonstrated n hts. Validated n blogies that enh n a laser threat otection of near	nologies for space d improved over sed yields for ro naterials and ma measured effects nance laser hard environment. r-infrared to sho	e vehicles and rall bust, high tterials s of space ening of Air rt-wave		1.420 1.320	0.000	0.000
(U) (U) (U) Proj	infrared staring focal plane arrays. In FY 2004: Develop optical limiter mater plane arrays. In FY 2005: Not Applicable. ect 5032	rials for the prot	ection of near- R-1 Sh	infrared to sho	nt-wave infrared	l staring focal 8			Exhibit R-2a (PE 0603500F)
				412	2					

	Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2004
BUDGET ACTIVITY 03 Advanced Technology Develor	oment (ATD)			PE NUMBER A 0603500F N DEV SPACE	ND TITLE IULTI-DISCIPL E TEC	INARY ADV	PROJECT NUM 5032 Advance	BER AND TITLE ced Space Ma	terials
 (U) MAJOR THRUST: Develop and or revolutionary improvements in the (U) In FY 2003: Identified and evalual large, lightweight, potentially load characterized ceramic and organicand weapon leading edges. (U) In FY 2004: Develop ceramic-bas shapes for load bearing structures in components. Initiate materials and second structures in the structures in the structures. Initiate materials and second structures. 	lemonstrate advan performance of a ted cryogenic flui bearing tank stru based composite ed materials (mor n space access sy design concent s	nced materials a ir breathing and d compatible m ctures for air-br materials for du nolithic and con stems and static tudy on durable	and processing te d rocket-based ac laterial and affor reathing and rock irable, very high posite) capable c turbine-based c	echnologies to er erospace vehicle dable processing tet-based vehicle temperature aer of being process ombined cycle a	hable s and weapons. g technologies fo es. Evaluated an ospace vehicle and into complex and scramjet	r d	3.641	9.839	0.000
 launch vehicles. Develop, character temperature protection systems in a high temperature protection seals. structures and propulsion system c compatibility, and durability. Den coatings coupled with advanced re reentry vehicles and high-Mach ve and hydrocarbon environments for protection for sensor and payload if (U) In FY 2005: Not Applicable. (ID) Total Cost 	reusable high-spe reusable high-spe Develop and asse components empha constrate innovati fractory composit hicles. Develop a air-breathing and n space systems a	e ceramic-based ed systems, esp ess metallic mat asizing increase ve material con- tes, for high-ten analytical mode l rocket-based v and initiate resea	materials (mono ecially for leadir erials (monolithi d operating temp cepts, such as ab operature protect ling tools to prece rehicles. Develo arch for agile inf	olithic and composite operature, environ- plative and oxida ion system leadi lict material beh p and assess jam rared filters.	exist systems for osite) for high surfaces, and e) for space accest umental tion - protection ng edges for avior in cryogen uming and damag	ss ic ge	6 381	11 615	0.000
(U) C. Other Program Funding Sum	mary (\$ in Milli	ons)					0.501	11.015	0.000
	<u>FY 2003</u> <u>Actual</u>	<u>FY 2004</u> Estimate	<u>FY 2005</u> <u>Estimate</u>	<u>FY 2006</u> <u>Estimate</u>	<u>FY 2007</u> Estimate	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
(U) PE 0602102F, Materials.									
(U) Multi-Disciplinary Space Technology.									
(U) PE 0603112F, Advanced Materials for Weapon Systems.									
(U) Coordinated through the Reliance process to harmonize efforts and eliminate									
Project 5032		F	R-1 Shopping List -	Item No. 27-7 of 2	27-18			Exhibit R-2a (I	PE 0603500F)

	Exhibit R-2a, RD	T&E Project Justification		DATE February 2004
BUD(03 A	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJEC 5032 A	T NUMBER AND TITLE
(U)	<u>C. Other Program Funding Summary (\$ in Millions)</u> duplication.			
(U)	D. Acquisition Strategy Not Applicable.			
Proj	ect 5032	R-1 Shopping List - Item No. 27-8 of 27-18		Exhibit R-2a (PE 0603500F)

	Ext	nibit R-2a, I	RDT&E Pro	oject Justi	fication			DATE	February	2004
BUDGI 03 Ac	ET ACTIVITY Ivanced Technology Development (ATD)			PE NUMBER AND 0603500F MUI DEV SPACE T	TITLE L TI-DISCIPLI EC	NARY ADV	PROJECT NUME 5033 Rocket Demonstratio	BER AND TITLE Propulsion On	
	Cost (\$ in Millions)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	Cost to	Total
	Cost (\$ in Minions)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
5033	Rocket Propulsion Demonstration	24.369	22.032	22.437	28.155	30.710	32.714	33.239	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
(U)	A. Mission Description and Budget Iten This project develops and demonstrates ac and advanced propellants for launch and of Systems Phase 1. Characteristics such as emphasized. Increased life and performant technologies for stationkeeping and on-ort propulsion systems, higher efficiency ener Technological advances developed in this operations, and support costs by ~30 percer will also lead to seven-year increase in sate costs, and a 15 percent increase in satellite Department of Defense, National Aeronau	n Justification dvanced and imporbit transfer prenvironmental nee of propulsion bit maneuverin rgy conversion program will it ent. Responsive tellite on-orbit te payload. The utics and Space	novative low-co opulsion. Add acceptability, a on systems are g applications. systems (deriv mprove the per veness and oper ime, a 50 perco efforts in this Administration	ost rocket turb itionally, this p affordability, r key goals. Th Technology a ed from an im formance of e rability of prop ent increase in project contrib n, and industry	oomachinery and project develops eliability, respor is project also de areas investigate proved understa xpendable system pulsion systems satellite maneuv pute to the Integr v effort to focus n	components, le technologies f asiveness, reduce evelops chemic d include groun nding of combu- ms' payload caj will be enhance vering capabilit ated High Payor rocket propulsi	ow-cost space for the Technolo ced weight, and cal, electrical, a nd demonstration ustion fundame pabilities by ~2 ed for reusable ty, a 25 percent off Rocket Propon technology	aunch propulsi ogy for Sustain I reduced opera nd solar rocket ons of compact, ntals), and high 0 percent, redu launch systems reduction in op pulsion Technol on national spa	on system tech ment of Strateg tion and launch propulsion syst , lightweight, ac n-energy propel ce the launch, s. Technology a cbit transfer ope logy program, a ce launch needs	nologies, ic 1 costs are tem dvanced lants. advances erational 1 joint s.
(U) <u>I</u> (U) M (U) I (U) I (U) I (U) I (U) I a s (U) (U)	 (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> (U) MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch vehicles. (U) MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch vehicles. (U) In FY 2003: Tested turbopumps for integration into an advanced hydrogen engine for the Integrated Powerhead Demonstration. Completed redesign and analysis of advanced hydrocarbon engines. (U) In FY 2004: Complete integration of components for the Integrated Powerhead Demonstration of advanced, long life, hydrogen-based engine technologies. Initiate component designs and analyses of hydrocarbon demonstration for reusable launch vehicle concepts. (U) In FY 2005: Complete testing for the Integrated Powerhead Demonstration. Enhance component designs and analyses of hydrocarbon demonstration for reusable launch vehicle concepts. Scale-up advanced cryogenic upper stage technologies including higher efficiency energy conversion systems (U) (U) MAIOR THRUST: Develop solar thermal and solar electric propulsion technologies for existing and future upper 3 363 3 600 2 							<u>FY 2005</u> 11.536		
(U) I	tage, orbit transfer vehicles, and satellite f n FY 2003: Completed demonstration of s	ormation flying	s, station keepin copulsion techn	ng, and reposition of the second seco	tioning. as strut developi	ment and		5.505	5.000	2.412
Proje	ct 5033		R-1 Sh	opping List - Ite	m No. 27-9 of 27-1	8			Exhibit R-2a (I	PE 0603500F)

	Exhibit R-2a, RDT&E Project Just	ification		DATE February	2004	
BUD 03 /	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJEC 5033 R Demon	PROJECT NUMBER AND TITLE 5033 Rocket Propulsion Demonstration		
(U) (U)	pointing and tracking, for orbit transfer and maneuvering propulsion technology. Developing high-power Hall thrusters capable geosynchronous-earth-orbit transfer. Tested initial capability of the advanced small s demonstration to develop microsatellite formation flying capability for Air Force imaging FY 2004: Continue program to develop electric propulsion systems for orbit-transfer. Prep small satellite propulsion demonstration unit for a microsatellite demonstration. In FY 2005: Advance development of electric propulsion systems for orbit-transfer b thrusters capable of low-earth orbit to geosynchronous-earth-orbit transfer. Complete satellite propulsion demonstration unit for a microsatellite demonstration.	veloped preliminary electric e of low-earth-orbit to atellite propulsion ging requirements. fer by developing high-power are for delivery of the advanced rting improved capability for y developing high-power Hall delivery of the advanced small blar electric/thermal technology				
(ID	developments improving power efficiency and thruster efficiency. Begin component thruster demonstration.	integration for a high power Hall				
(U)	MAJOR THRUST: Develop missile propulsion, aging, and surveillance technology f Missile to include demonstration of missile propulsion technology and Post Boost Co support Technologies for the Sustainment of Strategic Systems Program - Phase 1.	or Intercontinental Ballistic ntrol Systems (PBCS). Efforts	3.360	1.490	6.468	
(U)	In FY 2003: Demonstrated PBCS component technologies with available materials to maintain system performance. Tested strategic sustainment demonstration technologies propellant, case, and nozzle technologies and demonstrated cost and performance goa	o reduce hardware costs and es that integrated advanced ls.				
(U)	In FY 2004: Begin fabrication of final PBCS components for testing and demonstrati (to include propellant, case, and nozzle) for the interim strategic sustainment demonst	on. Fabricate final components ration motors.				
(U)	In FY 2005: Complete fabrication of components for the Post Boost Control demonst fabrication and begin integration and testing for the interim strategic sustainment dem assessment and fabrication of the final strategic sustainment demonstration motors.	tration test. Complete onstration motors. Commence				
an						
(U)	MAJOR THRUST: Develop electric and advanced chemical based monopropellant p future satellite propulsion systems.	ropulsion technologies for	0.373	1.922	2.021	
(U)	In FY 2003: Completed brassboard level testing of a pulsed plasma thruster system. testing of the thruster integrated with the power-processing unit. Enhanced developm Force small satellites required for key Air Force Space Command concepts. Complet verification testing of flight hardware for microsatellite demonstration spacecraft.	Completed preliminary hot fire ent of propulsion system for Air ed preliminary acceptance and				
(U)	In FY 2004: Demonstrate pulsed plasma thruster. Complete development of propuls satellites required for key Air Force Space Command Concepts. Develop advanced n	on system for Air Force small				
Dre	site for a space command concepts. Develop advanced in	am No. 27-10 of 27-18		Exhibit R 20 (F		
FIC	NJECT 3033 R-1 Shopping List - Itt	10 U ZI-10 U ZI-10			L 0003000F)	

		Exhibit R-	2a, RDT&E	Project Jus	stification			DAT	[∈] February	2004
BUD 03	OGET ACTIVITY Advanced Technology Developm	INARY ADV	PROJECT NU 5033 Rocke Demonstra	MBER AND TITLE et Propulsion tion						
(U) (U)	propulsion ground demonstration. In FY 2005: Demonstrate pulsed pla satellites required for key Air Force & propulsion ground demonstration.	asma thruster. C Space Command	Complete develo d Concepts. De	pment of propu velop advanced	lsion system for monopropellant	Air Force small and begin vehic	le			
(U)	MAJOR THRUST: Evaluate reusab	le hydrocarbon	scramjet techno	logy to support	rocket-based con	nbined cycle		6.097	0.000	0.000
(U)	In FY 2003: Evaluated reusable hyd cycle engines. Components evaluate Phase II hydrocarbon boost demonstr into combined cycle engine developr	rocarbon scram ed were consiste ration in FYs 20 nent, as well as	jet component to nt with Integrato 05-2006. Deter hydrocarbon en	echnology to su ed High Payoff rmined componen gine componen	pport rocket-bas Rocket Propulsio ent technologies ts for highly reus	ed combined on Technology to be integrated sable launch.				
(U)	In FY 2004: Not Applicable.									
(U)	In FY 2005: Not Applicable.									
(U) (U)	Total Cost							24.369	22.032	22.437
(U)	C. Other Program Funding Summ	<u>nary (\$ in Millio</u>	ons)							
		<u>FY 2003</u>	FY 2004	<u>FY 2005</u>	FY 2006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	Cost to	Total Cost
(U) (U)	PE 0602102F, Materials. PE 0602203F, Aerospace Propulsion. PE 0602500F, Multi Disciplinger: Space	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	Complete	
(U)	Technology. PE 0602601F, Spacecraft Technology.									
(U)	PE 0603114N, Power Projection Advanced Technology.									
(U)	PE 0603216F, Aerospace Propulsion Power Technology.									
(U)	PE 0603401F, Advanced Spacecraft Technology. PE 0603853F, Evolved									
Pr	niect 5033		R.	1 Shopping List -	Item No. 27-11 of	27-18			Exhibit R-22 (PE 0603500E)

	Exhibit R-2a, RDT&E Project Justification February 2004										
BUD 03	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJEC 5033 R Demor	T NUMBER AND TITLE Cocket Propulsion Instration							
(U) (U)	<u>C. Other Program Funding Summary (\$ in Millions)</u> Expendable Launch Vehicle Program. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.										
(U)	D. Acquisition Strategy Not Applicable.										
Pro	bject 5033	R-1 Shopping List - Item No. 27-12 of 27-18		Exhibit R-2a (PE 0603500F)							

Exhibit R-2a, RDT&E Project Justification							DATE	DATE February 2004		
BUDGET ACTIVITY PE NUMBER AND TITLE 03 Advanced Technology Development (ATD) 0603500F MULTI-DISCIPLINARY DEV SPACE TEC						NARY ADV	PROJECT NUMBER AND TITLE 5034 Advanced Space Sensors			
	Cost (\$ in Millions)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007 Estimate	FY 2008	FY 2009	Cost to	Total
		Actual	Estimate	Estimate	Estimate		Estimate	Estimate	Complete	
5034	Advanced Space Sensors	4.511	6.018	9.519	8.654	11.605	16.055	7.633	Continuing	TBD
Mate	Quantity of RDT&E Articles		0	0(02270E Dr	0	0	0	0		
Com: (U)	mission recommendation to consolidate all <u>A. Mission Description and Budget Iter</u> This project develops and demonstrates s sensors; laser warning sensors; targeting radar, laser, electronic combat, and ECCN	space unique a m Justification pace sensor tech and attack radar M technologies	nnologies, inclu sensors; and el for space applic	iding radio fre lectronic coun cations, this pr	quency sensors; ter-countermeas oject provides s	intelligence, su ures (ECCM) a pace platforms	arveillance, and and communica with the capab	l reconnaissanc ations. By deve ility to precisel	e sensors; elect cloping multi-fu y detect, track,	rro-optical inction and target
(U) (U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop a material signative paint/camouflage thermal reflectance feature measurements. In FY 2003: Performed chemical analyses validated a baseline predictive signature paint FY 2004: Develop a forward predictive analyses of an expanded target set and comenvironmental influences on spectral signation FY 2005: Expand the development of r Develop an enhanced system-level modelies the addition of polarimetric signatures.	(\$ in Millions) gnature analysis ires, and developed rediction model e capability valid tinue developin atures. naterial signatur ng capability th	capability to e p a forward pre an enhanced su for space-quali dated with emp g an enhanced re analysis rese at incorporates	valuate the ph dictive capabi urface scatterin ified hyperspec- irical measure surface scatter arch into the a additional sign	ysical/chemical lity validated with ng model. Deve ctral electro-option ring model. Assonates rrea of polarimet nature modalitie	origins of ith empirical loped and ical sensors. chemical ess ric signatures.	<u>FY</u>	<u>2003</u> 0.283	<u>FY 2004</u> 0.323	<u>FY 2005</u> 0.194
(U) (U) (U)	MAJOR THRUST: Develop and demonst resistance, positional accuracy, timing acc combat capabilities. In FY 2003: Designed advanced M-Code to provide precise time, position, and velo improved assessment of GPS anti-jam tech In FY 2004: Design direction finding tech enhanced offensive and defensive combat	rate technologie uracy, and explo technologies. I city for multiple mologies. mologies to may capabilities. De	es to maximize pitation techniq Developed assure platforms. De kimize Navigati evelop assured	Global Positio ues to improve red reference t emonstrated vi ion Warfare ex reference tech	oning System (G e offensive and technologies to o rtual flight test t xploitation techr nologies to prov	PS) jam defensive operate in space echnology for siques for ride precise	9	0.951	1.020	2.362
Proj	ect 5034		R-1 Sho	opping List - Iten	n No. 27-13 of 27-	18			Exhibit R-2a (I	PE 0603500F)
<u> </u>				41	9				· · · · · ·	,

	Exhibit R-2a, RDT&E Project Ju	DATE February 2004		
BUD 03 /	GET ACTIVITY Advanced Technology Development (ATD)	T NUMBER AND TITLE dvanced Space Sensors		
(U)	time, position, and velocity for on-board and off-board platform applications. Deve technology to assess anti-jam Global Positioning System (GPS) III techniques. In FY 2005: Demonstrate assured reference technologies to provide precise time, p and off-board platform applications. Demonstrate antenna wavefront simulation tec III techniques.	elop antenna wavefront simulation position, and velocity for on-board chnology to assess anti-jam GPS		
(U) (U) (U)	MAJOR THRUST: Develop and demonstrate advanced wide-band electronic combened encoding/pre-processing/sorting concepts and techniques to handle increasing digit signal environment for applications in existing and future space EC systems. In FY 2003: Developed requirements analysis and hardware and software designs esystems.	bat (EC) radio frequency receiver ization of the modern complex RF of future space electronic combat	0.430	0.000 0.000
(U) (U) (U)	In FY 2004: Not Applicable. In FY 2005: Not Applicable.	inves that will counter advanced	1 420	0.000 0.000
(U) (U) (U) (U)	MAJOK THRUST. Develop space-based support jaining technologies and technologies and technologies and technologies.In FY 2003: Completed study of and continued developing and assessing physical space-based support jamming technologies in space unique environments.In FY 2004: Not Applicable.In FY 2005: Not Applicable.	requirements for applying	1.430	0.000 0.000
(U) (U)	MAJOR THRUST: Develop space laser warning sensor technologies for timely al acquisition/tracking sensors, including detecting and locating both high power (daz (laser-guided ordnance) signals.	ert to advanced laser zle/damage) and low power	1.417	0.559 1.111
(U)	In FY 2003: Completed design of space-hardened processor, geolocation, and spec false alarm package hardware and began integration onto flight platform. Complete Performed risk reduction analysis for space-hardened geolocation, spectrometer, an initial components of space laser warning sensor modules.	trometer modules. Completed ed false alarm test planning. d processor modules. Fabricated		
(U) (U)	In FY 2004: Integrate false alarm package for space flight. Breadboard geolocation processor modules. Complete fabrication of space-qualified false alarm sensor modules. In FY 2005: Complete designs for space-qualified laser warning sensors for rapid of the space-qualified laser warning sensors for space-qualified laser warni	n, spectrometer, and algorithm lules. Plan for on-orbit testing. letection and characterization of		
	laser designators, trackers, dazzlers, and weapons. Develop geolocation, spectrome modules, and integrate false-alarm reduction techniques in preparation for space fli of space-qualified false-alarm sensor modules. Fabricate and integrate space-qualif	eter, and algorithm processor ght test. Initiate characterization fied components for space flight		
Pro	ject 5034 R-1 Shopping List -	Item No. 27-14 of 27-18		Exhibit R-2a (PE 0603500F)

		Exhibit R-	-2a, RDT&E	Project Jus	stification			DATE	February	2004
BUD 03 /	GET ACTIVITY Advanced Technology Develop	ment (ATD)			PE NUMBER A 0603500F N DEV SPACE	ND TITLE IULTI-DISCIPL E TEC	INARY ADV	PROJECT NUME 5034 Advanc	BER AND TITLE Eed Space Se	ensors
	engineering test unit. Develop mec testing, data collection, and system	chanical, electrica evaluation.	al, and functiona	al interfaces to a	host satellite. P	lan for on-orbit				
(U) (U)	 (U) (U) MAJOR THRUST: Develop advanced laser communication component and sub-system technology to support a network-level topology for Airborne Intelligence Surveillance and Reconnaissance (AISR). 						0.000	4.116	5.852	
 (U) In FY 2003: Not Applicable. (U) In FY 2004: Integrate and test electro-optical communication component technology into an airborne communication testbed, and evaluate performance with ground terminals under simulated space-to-ground, low elevation angle path lengths. Define requirements for laser communication channelization to develop multiple user access capability. Develop aircraft optical network technologies to switch and route high bandwidth laser communication signals to lower level radio frequency systems through a distributed fiber bus providing lower bandwidth link connectivity and 										
 redundancy. (U) In FY 2005: Develop an integrated electro-optical communication terminal for evaluation and testing of AISR links between an airborne communication testbed and ground terminals under simulated space to ground atmospheric conditions. Develop subsystem technologies for a shared radio frequency/electro-optical aperture to service high bandwidth communication needs. Examine applicability of shared apertures to multiple user access capability. Develop aircraft optical network to switch and route high bandwidth laser communication signals to lower level radio 										
(U)	Total Cost	Ī	6					4.511	6.018	9.519
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	ons)							
(U) (U) (U) (U)	PE 0602204F, Aerospace Sensors. PE 0602500F, Multi-Disciplinary Space Technology. PE 0603203F, Advanced Aerospace Sensors. PE 0603270F, Electronic Combat Technology. This project has been	Actual	<u>Estimate</u>	<u>Estimate</u>	Estimate	Estimate	Estimate	Estimate	Complete	<u>Total Cost</u>
Pro	ject 5034		R	-1 Shopping List -	Item No. 27-15 of 2	27-18			Exhibit R-2a ((PE 0603500F)

	DATE February 2004		
BUDGET A 03 Advar	CTIVITY Inced Technology Development (ATD)	PROJECT NUMBER AND TITLE 5034 Advanced Space Sensors	
(U) <u>C.O</u> Relia effor dupli	ther Program Funding Summary (\$ in Millions) ance process to harmonize ts and eliminate cation.		
(U) <u>D. A</u> Not	Applicable.		
Project 50	34	R-1 Shopping List - Item No. 27-16 of 27-18	Exhibit R-2a (PE 0603500F)

E	xhibit R-2a,	RDT&E Pro	oject Justi	fication			DATE	February	2004
BUDGET ACTIVITY 03 Advanced Technology Developmen	t (ATD)			PE NUMBER AND 0603500F MU DEV SPACE 1	D TITLE LTI-DISCIPLI FEC	NARY ADV	PROJECT NUMI 5062 Advanc Vehicles	BER AND TITLE Ced Structure	es for Space
Cost (\$ in Millions)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	Cost to	Total
5062 Advanced Structures for Space Vehicles	Actual 2.415	2.975	Estimate 0.000	Estimate 0 0.000	2.906	O.870	Estimate 0.460	Complete	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		
(U) <u>A. Mission Description and Budget In</u> This project identifies, develops, and de operability, responsiveness, and cost-eff controls. Technology demonstration in	tem Justification emonstrates the te fectiveness. Enal cludes multi-disc	cchnologies to obling technologi pling technologi plinary system	enable advance gies include the h level integration	ed access-to-spa ermal protection ion of the enabl	ce aerospace ve a, structures, ve ing technologie	ehicles that del hicle systems, ss.	iver revolutiona configurations,	ary capability, aerodynamics,	and
 (U) <u>B. Accomplishments/Planned Program</u> (U) MAJOR THRUST: Develop the airfram (U) In FY 2003: Developed the airframe and space systems including the thermal prot technologies that enable aerospace vehic cost-effectiveness. Investigated integrat these aerospace vehicle configurations stairbreathing-based hypersonic propulsio (U) In FY 2004: Continue developing the air access to space systems including the the technologies that enable aerospace vehicle cost-effectiveness. 	n (\$ in Millions) ne and payload technol depayload technol tection, structural eles to exhibit reve ion of the multidi uch as materials, s n. rframe and paylo ermal protection, eles to exhibit reve	chnologies requ ogies required , configuration olutionary capa sciplinary tech munitions, hun ad technologies structural, cont olutionary capa	tired to enable to enable next , and vehicle an ability, operabinologies require nan effectivene s required to en figuration and subility, operabi	horizontal laun generation reus nd payload syst lity, responsive red to design an ess, and both roo nable next gener vehicle and pay lity, responsive	ch. sable access to em ness, and d demonstrated cket- and ration reusable load system ness, and		<u>7 2003</u> 2.415	<u>FY 2004</u> 2.975	<u>FY 2005</u> 0.000
(U) In FY 2005: Not Applicable. Efforts in(U) Total Cost	this project will b	be delayed unti	1 FY 2007 due	to higher Air F	orce priorities.		2.415	2.975	0.000
(U) <u>C. Other Program Funding Summary</u> <u>I</u> PE 0602500F,	<u>v (\$ in Millions)</u> FY 2003 F <u>Actual E</u>	<u>Y 2004]</u> stimate	<u>FY 2005</u> Estimate	<u>FY 2006</u> <u>Estimate</u>	<u>FY 2007</u> Estimate	FY 2008 Estimate	<u>FY 2009</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
(U) Multi-Disciplinary Space Technology.									
Project 5062		R-1 Sh	opping List - Iten	n No. 27-17 of 27	-18			Exhibit R-2a	(PE 0603500F)
423									

	Exhibit R-2a, RI	DATE February 2004				
BUD(03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJEC 5062 A Vehicl	PROJECT NUMBER AND TITLE 5062 Advanced Structures for Space Vehicles		
(U) (U)	C. Other Program Funding Summary (\$ in Millions) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.					
(U)	D. Acquisition Strategy Not Applicable.					
Proj	ect 5062	R-1 Shopping List - Item No. 27-18 of 27-18		Exhibit R-2a (PE 0603500F)		