DEPARTMENT OF THE AIR FORCE

FISCAL YEAR (FY) 2007 BUDGET ESTIMATES

RESEARCH, DEVELOPMENT, TEST AND EVALUATION (RDT&E)

DESCRIPTIVE SUMMARIES, VOLUME I

SCIENTIFIC AND TECHNOLOGY BUDGET ACTIVITIES 1 - 3

FEBRUARY 2006

Fiscal Year 2007 Budget Estimates
RDT&E Descriptive Summaries, Volume I
Scientific and Technology Budget Activities 1 - 3
February 2006

INTRODUCTION AND EXPLANATION OF CONTENTS

1. (U) GENERAL
   A. This document has been prepared to provide information on the United States Air Force (USAF) Research, Development, Test and Evaluation (RDT&E) program elements and projects in the FY 2007 President's Budget.
      1) All exhibits in this document have been assembled in accordance with DoD 7000.14R, Financial Management Regulation, Volume 2B, Chapter 5, Section 050402. Exception:
         a) Exhibit R-1, RDT&E Program, which was distributed under a separate cover due to classification.
      2) Other comments on exhibit contents in this document:
         a) Exhibits R-2/2a and R-3 provide narrative information for all RDT&E program elements and projects within the USAF FY 2007 RDT&E program with the exception of classified program elements. The formats and contents of this document are in accordance with the guidelines and requirements of the Congressional committees insofar as possible.
         b) The "Other Program Funding Summary" portion of the R-2 includes, in addition to RDT&E funds, Procurement funds and quantities, Military Construction appropriation funds on specific development programs, Operations and Maintenance appropriation funds where they are essential to the development effort described, and where appropriate, Department of Energy (DOE) costs.
         c) "Facilities Exhibits", Military Construction Project Data, (DD 1391), for improvements to and construction of government-owned facilities funded in RD&E, are included at the end of Volume III.

2. (U) CLASSIFICATION
   A. All exhibits contained in Volumes I, II, and III are unclassified. Classified exhibits are not included in the submission due to the level of security classification and necessity of special security clearances.

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USAF Modeling and Simulation	0207601F	1523
Warfighter Rapid Acquisition Program	0203761F	1289
Wargaming and Simulation Centers	0207605F	1547
Distributed Training and Exercises	0207697F	1553
WEATHER SERVICE	0305111F	1711
Wideband MILSATCOM (Space)	0603854F	659
WWMCCS/GLOBAL COMMAND & CONTROL SYSTEM	0303150F	1645

DEPARTMENT OF DEFENSE

FY 2007 RDT&E PROGRAM

SUMMARY
($ IN THOUSANDS)

02 FEB 2006

APPROPRIATION	FY 2005	FY 2006	FY 2007
Research, Development, Test & Eval, AF	20,477,909	21,671,763	24,396,767
Total Research, Development, Test & Evaluation	20,477,909	21,671,763	24,396,767

DEPARTMENT OF DEFENSE

FY 2007 RDT&E PROGRAM

SUMMARY
($ IN THOUSANDS)

02 FEB 2006

Summary Recap of Budget Activities	FY 2005	FY 2006	FY 2007
Basic Research	373,798	362,607	370,206
Applied Research	923,608	1,070,572	973,094
Advanced Technology Development	925,181	1,010,491	804,836
Advanced Component Development & Prototypes	1,767,113	2,201,113	2,741,701
System Development & Demonstration	4,341,382	4,830,329	4,571,330
RDT&E Management Support	1,128,533	968,297	1,042,276
Operational Systems Development	11,018,294	11,228,354	13,893,324
Total Research, Development, Test & Evaluation	20,477,909	21,671,763	24,396,767

Summary Recap of FYDP Programs			
Strategic Forces	84,178	93,243	151,821
General Purpose Forces	3,090,493	3,490,786	4,222,700
Intelligence and Communications	7,805,406	7,597,391	9,313,073
Mobility Forces	780,718	842,068	917,294
Research and Development	8,454,154	9,465,541	9,497,133
Central Supply and Maintenance	126,641	133,994	232,770
Training Medical and Other	3,246	3,320	3,491
Administration and Associated Activities	129,276	41,734	54,574
Support of Other Nations	3,797	3,686	3,911
Total Research, Development, Test & Evaluation	20,477,909	21,671,763	24,396,767

DEPARTMENT OF THE AIR FORCE

FY 2007 RDT&E PROGRAM

SUMMARY
($ IN THOUSANDS)

02 FEB 2006

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DEPARTMENT OF THE AIR FORCE
FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 3600F Research, Development, Test & Eval, AF

Date: 02 FEB 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
1	0601102F	Defense Research Sciences	01	246,414	241,436	250,232	U
2	0601103F	University Research Initiatives	01	115,506	108,757	107,571	U
3	0601108F	High Energy Laser Research Initiatives	01	11,878	12,414	12,403	U
	Basic Research			373,798	362,607	370,206	
4	0602015F	Medical Development	02		18,434		U
5	0602102F	Materials	02	117,460	121,451	111,073	U
6	0602201F	Aerospace Vehicle Technologies	02	75,195	104,469	112,751	U
7	0602202F	Human Effectiveness Applied Research	02	83,867	108,171	92,991	U
8	0602203F	Aerospace Propulsion	02	129,190	155,673	170,885	U
9	0602204F	Aerospace Sensors	02	92,597	115,689	117,553	U
10	0602500F	Multi-disciplinary Space Technology	02	91,773	91,694		U
11	0602601F	Space Technology	02	102,928	104,392	85,594	U
12	0602602F	Conventional Munitions	02	50,821	62,061	62,105	U
13	0602605F	Directed Energy Technology	02	42,754	44,169	48,422	U
14	0602702F	Command Control and Communications	02	84,201	96,714	119,267	U
15	0602805F	Dual Use Science and Technology Program	02	3,955	986		U
16	0602890F	High Energy Laser Research	02	48,867	46,669	50,166	U
17	0207170F	Joint Helmet Mounted Cueing System (JHMCS)	02			2,287	U
	Applied Research			923,608	1,070,572	973,094	
18	0603112F	Advanced Materials for Weapon Systems	03	61,305	70,100	48,901	U

DEPARTMENT OF THE AIR FORCE
FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 3600F Research, Development, Test & Eval, AF

Date: 02 FEB 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
19	0603203F	Advanced Aerospace Sensors	03	41,607	39,782	55,150	U
20	0603211F	Aerospace Technology Dev/Demo	03	34,717	53,657	27,424	U
21	0603216F	Aerospace Propulsion and Power Technology	03	76,110	97,163	115,546	U
22	0603231F	Crew Systems and Personnel Protection Technology	03	29,375	34,968	32,156	U
23	0603270F	Electronic Combat Technology	03	37,883	33,342	24,436	U
24	0603311F	Ballistic Missile Technology	03	11,288	11,435		U
25	0603400F	Joint Unmanned Combat Air Systems (J-UCAS) Advanced Technology Dev and Research	03		76,691		U
26	0603401F	Advanced Spacecraft Technology	03	80,832	85,564	68,026	U
27	0603444F	Maui Space Surveillance System (MSSS)	03	56,561	47,166	6,074	U
28	0603500F	Multi-disciplinary Advanced Development Space Technology	03	47,676	55,732		U
29	0603601F	Conventional Weapons Technology	03	24,680	30,519	19,658	U
30	0603605F	Advanced Weapons Technology	03	49,782	49,821	51,336	U
31	0603723F	Environmental Engineering Technology	03		1,873		U
32	0603789F	C3I Advanced Development	03	31,595	41,124	35,785	U
33	0603801F	Special Programs	03	306,646	275,841	316,605	U
34	0603850F	Integrated Broadcast Service	03	2,235			U
35	0603924F	High Energy Laser Advanced Technology Program	03	9,490	5,713	3,713	U
36	0207418F	Tactical Airborne Control Systems	03			26	U
37	0207423F	Advanced Communications Systems	03	14,767			U

DEPARTMENT OF THE AIR FORCE
FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 3600F Research, Development, Test & Eval, AF

Date: 02 FEB 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
38	0401840F	AMC Command and Control System	03	5,803			U
39	0804757F	Joint National Training Center	03	2,829			U
		Advanced Technology Development		925,181	1,010,491	804,836	
40	0603260F	Intelligence Advanced Development	04	4,567	4,761	4,776	U
41	0603287F	Physical Security Equipment	04	25,915	25,563	298	U
42	0603421F	NAVSTAR Global Positioning System III	04	33,773	85,172	315,314	U
43	0603430F	Advanced EHF MILSATCOM (SPACE)	04	607,254	655,779	633,258	U
44	0603432F	Polar MILSATCOM (SPACE)	04	894	2,154	35,685	U
45	0603438F	Space Control Technology	04	14,493	15,606	27,076	U
46	0603742F	Combat Identification Technology	04	23,634	51,146	26,517	U
47	0603790F	NATO Research and Development	04	3,819	3,916	4,095	U
48	0603791F	International Space Cooperative R&D	04	532	566	593	U
49	0603845F	Transformational SATCOM (TSAT)	04	443,960	429,244	867,102	U
50	0603850F	Integrated Broadcast Service	04	23,309	15,063	20,592	U
51	0603851F	Intercontinental Ballistic Missile	04	56,908	57,087	45,538	U
52	0603854F	Wideband Gapfiller System RDT&E (Space)	04	54,413	92,287	37,672	U
53	0603858F	Space Radar	04	67,820	98,253	266,401	U
54	0603859F	Pollution Prevention	04	4,768	10,483	2,853	U
55	0603860F	Joint Precision Approach and Landing Systems	04	12,623	10,951	10,011	U
56	0604015F	Next Generation Bomber	04	28,877	24,777	25,598	U
57	0604327F	Hard and Deeply Buried Target Defeat System (HDBTDS) Program	04	5,239	3,943		U

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FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 3600F Research, Development, Test & Eval, AF

Date: 02 FEB 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
58	0604400F	Joint Unmanned Combat Air Systems (J-UCAS) Advanced Component and Prototype Deve	04		227,857		U
59	0604855F	Operationally Responsive Launch	04	32,142	38,519		U
60	0604856F	Common Aero Vehicle (CAV)	04	16,053	26,993	33,386	U
61	0604857F	Operationally Responsive Space	04			35,625	U
62	0207423F	Advanced Communications Systems	04		1,940		U
63	0305178F	National Polar-Orbiting Operational Environmental Satellite System (NPOESS)	04	306,120	319,053	349,311	U
		Advanced Component Development & Prototypes		1,767,113	2,201,113	2,741,701	
64	0603840F	Global Broadcast Service (GBS)	05	21,797	19,383	23,599	U
65	0604012F	Joint Helmet Mounted Cueing System (JHMCS)	05	2,245	2,870	2,792	U
66	0604222F	Nuclear Weapons Support	05	13,344	13,951	14,895	U
67	0604226F	B-1B	05	79,201	95,910	130,546	U
68	0604233F	Specialized Undergraduate Flight Training	05	2,785	8,472	3,703	U
69	0604239F	F-22	05	211,815	75,117		U
70	0604240F	B-2 Advanced Technology Bomber	05	263,550	294,898	224,177	U
71	0604261F	Personnel Recovery Systems	05			254,310	U
72	0604270F	Electronic Warfare Development	05	100,865	91,169	87,784	U
73	0604280F	Joint Tactical Radio	05	36,109	81,036		U
74	0604287F	Physical Security Equipment	05	9,381	10,994	93	U
75	0604329F	Small Diameter Bomb (SDB)	05	73,573	63,521	104,080	U
76	0604421F	Counterspace Systems	05	25,351	29,074	47,292	U

DEPARTMENT OF THE AIR FORCE
FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 3600F Research, Development, Test & Eval, AF

Date: 02 FEB 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
77	0604425F	Space Situation Awareness Systems	05			121,157	U
78	0604429F	Airborne Electronic Attack	05		119,262	12,421	U
79	0604441F	Space Based Infrared System (SBIRS) High EMD	05	587,121	696,562	668,902	U
80	0604443F	Alternative Infrared Space System (AIRSS)	05			102,962	U
81	0604479F	Milstar LDR/MDR Satellite Communications (SPACE) (H)	05	1,056			U
82	0604600F	Munitions Dispenser Development	05	25,870	5,952		U
83	0604602F	Armament/Ordnance Development	05	8,015	7,675	5,039	U
84	0604604F	Submunitions	05	5,682	5,397	5,759	U
85	0604617F	Agile Combat Support	05	16,989	11,211	10,095	U
86	0604618F	Joint Direct Attack Munition	05			15,450	U
87	0604706F	Life Support Systems	05	8,333	13,373	12,370	U
88	0604735F	Combat Training Ranges	05	15,712	8,794	14,363	U
89	0604740F	Integrated Command & Control Applications (IC2A)	05	21,279	18,872	167	U
90	0604750F	Intelligence Equipment	05	2,426	2,730	1,426	U
91	0604762F	Common Low Observables Verification System (CLOVerS)	05	8,940	8,568		U
92	0604800F	Joint Strike Fighter (JSF)	05	2,080,058	2,333,009	1,999,068	U
93	0604851F	Intercontinental Ballistic Missile	05	94,684	31,948		U
94	0604853F	Evolved Expendable Launch Vehicle Program (SPACE)	05	20,991	25,721	18,513	U
95	0605011F	RDT&E for Aging Aircraft	05	25,249	41,090	25,490	U
96	0605807F	Test and Evaluation Support	05		49,288	2,388	U

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FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 3600F Research, Development, Test & Eval, AF

Date: 02 FEB 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
97	0207434F	Link-16 Support and Sustainment	05	120,633	161,345	172,625	U
98	0207443F	Family of Interoperable Operational Pictures (FIOP)	05	43,440	28,880		U
99	0207450F	E-10 Squadrons	05	390,957	391,006	390,896	U
100	0207451F	Single Integrated Air Picture (SIAP)	05			40,124	U
101	0207701F	Full Combat Mission Training	05	9,756	26,046	32,243	U
102	0305176F	Combat Survivor Evader Locator	05		17,250		U
103	0401318F	CV-22	05	14,175	39,955	26,601	U
		System Development & Demonstration		4,341,382	4,830,329	4,571,330	
104	0604256F	Threat Simulator Development	06	32,975	32,083	38,131	U
105	0604759F	Major T&E Investment	06	58,628	64,014	58,506	U
106	0605101F	RAND Project Air Force	06	30,609	27,139	25,211	U
107	0605306F	Ranch Hand II Epidemiology Study	06	4,663	4,128		U
108	0605502F	Small Business Innovation Research	06	349,650			U
109	0605712F	Initial Operational Test & Evaluation	06	27,392	34,122	34,802	U
110	0605807F	Test and Evaluation Support	06	358,584	636,369	740,134	U
111	0605860F	Rocket Systems Launch Program (SPACE)	06	21,975	26,391	14,704	U
112	0605864F	Space Test Program (STP)	06	44,705	47,308	46,310	U
113	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support	06	73,015	61,080	54,683	U
114	0605978F	Facilities Sustainment - Test and Evaluation Support	06	22,011	31,650	25,579	U
115	0804731F	General Skill Training	06	311	327	305	U

DEPARTMENT OF THE AIR FORCE
FY 2007 RDT&E PROGRAM

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APPROPRIATION: 3600F Research, Development, Test & Eval, AF

Date: 02 FEB 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
116	0909900F	Financing for Expired Account Adjustments	06	218			U
117	0909980F	Judgment Fund Reimbursement	06	100,000			U
118	1001004F	International Activities	06	3,797	3,686	3,911	U
	RDT&E Management Support			1,128,533	968,297	1,042,276	
119	0605024F	Anti-Tamper Technology Executive Agency	07	7,345	7,715	8,014	U
120	0605798F	Analysis Support Group	07				
121	0101113F	B-52 Squadrons	07	29,782	26,748	71,379	U
122	0101120F	Advanced Cruise Missile	07	6,609	1,960	6,983	U
123	0101122F	Air-Launched Cruise Missile (ALCM)	07	6,495	2,218	3,736	U
124	0101313F	Strat War Planning System - USSTRATCOM	07	13,472	29,705	27,285	U
125	0101314F	Night Fist - USSTRATCOM	07	4,786	4,941	5,162	U
126	0101815F	Advanced Strategic Programs	07	8,313	9,734	22,423	U
127	0102326F	Region/Sector Operation Control Center Modernization Program	07	14,721	17,937	14,853	U
128	0203761F	Warfighter Rapid Acquisition Process (WRAP) Rapid Transition Fund	07	34,697	22,764	30,584	U
129	0207131F	A-10 Squadrons	07	29,878	56,025	80,771	U
130	0207133F	F-16 Squadrons	07	95,664	154,533	148,373	U
131	0207134F	F-15E Squadrons	07	127,112	143,572	125,062	U
132	0207136F	Manned Destructive Suppression	07	16,143	9,260	515	U
133	0207138F	F/A-22 Squadrons	07	318,369	373,124	584,290	U
134	0207141F	F-117A Squadrons	07	17,385	13,406	14,093	U

DEPARTMENT OF THE AIR FORCE
FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 3600F Research, Development, Test & Eval, AF

Date: 02 FEB 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
135	0207161F	Tactical AIM Missiles	07	5,346	15,416	8,850	U
136	0207163F	Advanced Medium Range Air-to-Air Missile (AMRAAM)	07	31,871	32,788	43,417	U
137	0207224F	Combat Rescue and Recovery	07	6,460	70,801		U
138	0207247F	AF TENCAP	07	17,010	11,661	11,202	U
139	0207248F	Special Evaluation Program	07	195,663	273,167	530,038	U
140	0207253F	Compass Call	07	3,952	9,907	4,469	U
141	0207268F	Aircraft Engine Component Improvement Program	07	141,803	151,082	154,319	U
142	0207277F	CSAF Innovation Program	07	1,780	1,695	1,612	U
143	0207325F	Joint Air-to-Surface Standoff Missile (JASSM)	07	43,298	66,042	40,881	U
144	0207410F	Air & Space Operations Center (AOC)	07	22,301	67,029	87,483	U
145	0207412F	Control and Reporting Center (CRC)	07	9,660	18,892	8,798	U
146	0207417F	Airborne Warning and Control System (AWACS)	07	273,971	119,746	165,820	U
147	0207418F	Tactical Airborne Control Systems	07			2,286	U
148	0207423F	Advanced Communications Systems	07	17,940	30,968	53,093	U
149	0207424F	Evaluation and Analysis Program	07	2,501	6,013		U
150	0207433F	Advanced Program Technology	07	243,801	296,063	313,251	U
151	0207438F	Theater Battle Management (TBM) C4I	07	34,948	39,787	31,835	U
152	0207445F	Fighter Tactical Data Link	07	35,668	119,965	113,388	U
153	0207446F	Bomber Tactical Data Link	07	76,568	142,800	168,168	U
154	0207448F	C2ISR Tactical Data Link	07	24,420	14,627	4,338	U

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FY 2007 RDT&E PROGRAM

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APPROPRIATION: 3600F Research, Development, Test & Eval, AF

Date: 02 FEB 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
155	0207449F	Command and Control (C2) Constellation	07	38,288	40,334	44,027	U
156	0207581F	Joint Surveillance/Target Attack Radar System (JSTARS)	07	98,394	104,321	152,696	U
157	0207590F	Seek Eagle	07	22,316	19,232	16,426	U
158	0207591F	Advanced Program Evaluation	07	408,231	286,131	437,057	U
159	0207601F	USAF Modeling and Simulation	07	10,784	25,145	23,470	U
160	0207605F	Wargaming and Simulation Centers	07	6,993	6,278	6,595	U
161	0207697F	Distributed Training and Exercises	07		4,162	6,138	U
162	0208006F	Mission Planning Systems	07	87,659	119,860	146,396	U
163	0208021F	Information Warfare Support	07	10,066	14,973	24,758	U
164	0301310F	National Air Intelligence Center	07				
165	0301314F	COBRA BALL	07				
166	0301315F	Missile and Space Technical Collection	07				
167	0301324F	FOREST GREEN	07				
168	0301386F	GDIP Collection Management	07				
169	0302015F	E-4B National Airborne Operations Center (NAOC)	07	13,801	18,639	283	U
170	0303131F	Minimum Essential Emergency Communications Network (MEECN)	07	17,973	48,327	64,109	U
171	0303140F	Information Systems Security Program	07	65,702	116,532	183,523	U
172	0303141F	Global Combat Support System	07	20,645	20,262	19,895	U
173	0303150F	Global Command and Control System	07	5,096	13,306	3,348	U
174	0303158F	Joint Command and Control Program (JC2)	07		5,125	5,818	U

DEPARTMENT OF THE AIR FORCE
FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 3600F Research, Development, Test & Eval, AF

Date: 02 FEB 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
175	0303601F	MILSATCOM Terminals	07	245,582	269,218	271,562	U
176	0304111F	Special Activities	07				
177	0304260F	Airborne SIGINT Enterprise	07		77,798	117,834	U
178	0304311F	Selected Activities	07				
179	0304346F	Imagery Derived MASINT	07				
180	0304347F	Overhead Non-Imaging Infrared	07				
181	0305099F	Global Air Traffic Management (GATM)	07	6,727	6,943	6,620	U
182	0305110F	Satellite Control Network (SPACE)	07	19,379	31,170	19,907	U
183	0305111F	Weather Service	07	16,848	28,222	34,899	U
184	0305114F	Air Traffic Control, Approach, and Landing System (ATCALS)	07	12,512	2,169		U
185	0305116F	Aerial Targets	07	2,909	6,547	5,203	U
186	0305124F	Special Applications Program	07				
187	0305128F	Security and Investigative Activities	07	663	484	509	U
188	0305142F	Applied Technology and Integration	07				
189	0305148F	Measurement and Signature Intelligence (MASINT) Systems/ Program	07	13,811			U
190	0305159F	Defense Reconnaissance Support Activities (SPACE)	07				
191	0305160F	Defense Meteorological Satellite Program (SPACE)	07		3,852	969	U
192	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	07	93,408	123,794	131,083	U
193	0305165F	NAVSTAR Global Positioning System (Space and Control Segments)	07	128,349	184,756	177,792	U

DEPARTMENT OF THE AIR FORCE
FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 3600F Research, Development, Test & Eval, AF

Date: 02 FEB 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
194	0305172F	Combined Advanced Applications	07				
195	0305173F	Space and Missile Test and Evaluation Center	07			4,675	U
196	0305174F	Space Warfare Center	07	397	405	726	U
197	0305182F	Spacelift Range System (SPACE)	07	46,056	49,081	38,044	U
198	0305193F	Intelligence Support to Information Operations (IO)	07	1,087	3,566	3,813	U
199	0305202F	Dragon U-2	07	83,862	10,013		U
200	0305206F	Airborne Reconnaissance Systems	07	60,633	55,737	52,824	U
201	0305207F	Manned Reconnaissance Systems	07	23,364	18,074	10,132	U
202	0305208F	Distributed Common Ground/Surface Systems	07	31,470	34,883	120,777	U
203	0305219F	Predator UAV (JMIP)	07	82,113	64,081	61,466	U
204	0305220F	Global Hawk UAV	07	382,557	327,697	247,665	U
205	0305221F	Network-Centric Collaborative Target (TIARA)	07		8,524	8,499	U
206	0305887F	Intelligence Support to Information Warfare	07	923	961	5,163	U
207	0305906F	NCMC - TW/AA System	07	61,701	57,329	50,908	U
208	0305910F	SPACETRACK (SPACE)	07	129,438	164,190		U
209	0305913F	NUDET Detection System (SPACE)	07	34,691	32,266	60,281	U
210	0305917F	Space Architect	07	14,701	12,676		U
211	0305924F	National Security Space Office	07			13,437	U
212	0305940F	Space Situation Awareness Operations	07			31,401	U
213	0307141F	NASS, IO Technology Integration & Tool Dev	07	13,100	14,965	15,449	U

DEPARTMENT OF THE AIR FORCE
FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 3600F Research, Development, Test & Eval, AF

Date: 02 FEB 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
214	0308699F	Shared Early Warning (SEW)	07	3,183	3,235	2,999	U
215	0401115F	C-130 Airlift Squadron	07	158,716	232,173	248,283	U
216	0401119F	C-5 Airlift Squadrons (IF)	07	311,508	223,252	150,209	U
217	0401130F	C-17 Aircraft (IF)	07	195,042	164,781	173,781	U
218	0401132F	C-130J Program	07	13,247	6,586	40,542	U
219	0401133F	Aeromedical Evacuation	07		2,047		U
220	0401134F	Large Aircraft IR Countermeasures (LAIRCM)	07	69,069	58,596	34,916	U
221	0401218F	KC-135s	07	1,931	1,477	1,126	U
222	0401219F	KC-10s	07		13,280	4,781	U
223	0401221F	KC-135 Tanker Replacement	07	10,200	97,797	203,932	U
224	0401839F	Air Mobility Tactical Data Link	07			32,099	U
225	0408011F	Special Tactics / Combat Control	07	1,027	2,124	1,024	U
226	0702207F	Depot Maintenance (Non-IF)	07	1,328	1,388	1,457	U
227	0702239F	Avionics Component Improvement Program	07	976			U
228	0702806F	Acquisition and Management Support	07	5,110	4,735	17,706	U
229	0708011F	Industrial Preparedness	07	62,501	55,137	36,673	U
230	0708012F	Logistics Support Activities	07	962	2,760		U
231	0708610F	Logistics Information Technology (LOGIT)	07	3,000	43,384	166,338	U
232	0708611F	Support Systems Development	07	52,764	26,590	10,596	U
233	0804757F	Joint National Training Center	07		2,883	3,073	U
234	0808716F	Other Personnel Activities	07	106	110	113	U
235	0901202F	Joint Personnel Recovery Agency	07		964	992	U

DEPARTMENT OF THE AIR FORCE
FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 3600F Research, Development, Test & Eval, AF

Date: 02 FEB 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
236	0901218F	Civilian Compensation Program	07	14,608	7,339	7,779	U
237	0901220F	Personnel Administration	07		16,150	18,262	U
238	0901538F	Financial Management Information Systems Development	07	14,450	17,281	27,541	U
		Operational Systems Development		11,018,294	11,228,354	13,893,324	
		Total Research, Development, Test & Eval, AF		20,477,909	21,671,763	24,396,767	

PROGRAM ELEMENT COMPARISON SUMMARY

PROGRAM ELEMENT (By BUDGET ACTIVITY)		REMARKS
BUDGET ACTIVITY #1: BASIC RESEARCH (Volume 1)		
None		
BUDGET ACTIVITY #2: APPLIED RESEARCH (Volume 1)		
0602102F	Materials	In FY 2007, Project 01SP, Space Materials Development, is a new start. Efforts will transfer from PE 0602500F, Multidisciplinary Space Technology, Project 5025, Space Materials Development, in order to more effectively manage and provide oversight of the efforts.
0602201F	Aerospace Vehicle Technologies	In FY 2007, Project 6266SP, Applied Space Access Vehicle Technology, is a new start. Efforts were transferred from PE 0602500F, Multidisciplinary Space Technology, Project 625030, Applied Space Access Vehicle Technology, in order to effectively manage and provide oversight of the efforts.
0602203F	Aerospace Propulsion	In FY 2007, Project 33SP, Space Rocket Component Technology, is a new start. It will transfer from PE 0602500F, Multi-Disciplinary Space Technology, Project 5026, Rocket Propulsion Component Technology, and Project 5027, High Speed Airbreathing Propulsion Technology, in order to more effectively manage and provide oversight of the efforts. In FY 2006 and 2007, funding was increased to accelerate efforts to develop technologies to support an Air Force scramjet effort.
0602204F	Aerospace Sensors	In FY 2007, Project 44SP, Space Sensors, is a new start. Efforts will transfer from PE 0602500F, Multidisciplinary Space Technology, Project 5028, Space Sensors, Photonics and RF Processors, and Project 5029, Space Sensor and CM Technology, in order to more effectively manage and provide oversight of the efforts.

0602500F	Multi-Disciplinary Space Tech	In FY 2007, Project 5023, Laser and Imaging Space Technology, efforts transfer to PE 0602605F, Directed Energy Technology, Project 6255SP, Laser and Imaging Space Technology; Project 5025, Space Materials Development, efforts transfer to PE 0602102F, Materials, Project 6210SP, Space Materials Development; Project 5026, Rocket Propulsion Component Technology, and Project 5027, High Speed Airbreathing Propulsion Technology, efforts transfer to PE 0602203F, Aerospace Propulsion, Project 6233SP, Space Rocket Component Technology; Project 5028, Space Sensors, Photonics and Radio Frequency (RF) Processes, and Project 5029, Space Sensor and Countermeasure (CM) Technology, efforts transfer to PE 0602204F, Aerospace Sensors, Project 6244 SP, Space Sensors; Project 5030, Applied Space Access Vehicle Technology, efforts transfer to PE 0602201F, Aerospace Vehicle Technologies, Project 6222SP, Applied Space Access Vehicle Technology; and Project 5082, Optical Networking Technology, efforts transfer to PE 0602702F, Command Control and Communication, Project 6266SP, Space Optical Network Technology, in order to more effectivel
0602605F	Directed Energy Technology	In FY 2007, efforts will transfer from PE 0602500F, Multidisciplinary Advanced Development Space Technology, Project 5023, Laser and Imaging Space Tech, to this project in order to more effectively manage and provide oversight of the efforts. In FY2007, this is a new start.
0602702F	Command Control and Communications	In FY 2007, Project 6266SP, Space Optical Network Technology, is a new start. Efforts were transferred from PE 0602500F, Multidisciplinary Space Technology, Project 5082, Optical Networking Technology, in order to more effectively manage and provide oversight of the efforts.

BUDGET ACTIVITY #3: ADVANCED TECHNOLOGY DEVELOPMENT (Volume 1)

0603112F	Advanced Materials for Weapon Systems	In FY 2007, Project 77SP, Advanced Space Materials, is a new start. Efforts will be transferred from PE 0603500F, Multidisciplinary Space Technology, Project 5032, Advanced Space Materials, in order to more effectively manage and provide oversight of the efforts.
0603203F	Advanced Aerospace Sensors	In FY 2007, efforts will transfer from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5034, Advanced Space Sensors, to this project in order to more effectively manage and provide oversight of the efforts. In FY2007, this is a new start.
0603211F	Aerospace Technology Dev/Demo	In FY 2007, Project 6399SP, Advanced Structures for Space Vehicles, is a new start. Efforts were transferred from PE 0603500F, Multidisciplinary Advanced Space Technology, Project 635062, Advanced Structures for Space Vehicles, order to effectively manage and provide oversight of the efforts.

0603216F	Aerospace Propulsion and Power Technology	In FY 2007, a portion of the funding in Projects 2480 and 4921 was shifted to Project 5098. In FY 2007, Project 310SP, Space Rocket Propulsion Demonstration, is a new start and will transfer from PE 0603500F, Multi-Disciplinary Advanced Development Space Technology, Project 5033, Rocket Propulsion Demonstration, in order to more effectively manage and provide oversight of the efforts. In 2007, funding increases to support ground demonstrations and fabricate test vehicles for out-year flight demonstrations.
0603400F	J-UCAS Joint Program Office	In FY2007-11, the J-UCAS program is being terminated and $1,830.5M is being realigned to PE0604402N.
0603500F	Multi-Disciplinary Adv Dev Space Tech	In FY 2007, Project 5031, efforts transfer to PE 0603605F, Project 6311SP, Advanced Optics and Laser Space Technology; Project 5032, efforts transfer to PE 0603112F, Advanced Materials for Weapons Systems, Project 6377SP, Advanced Space Materials; Project 5033, efforts transfer to PE 0603216F, Aerospace Propulsion and Power Technology, Project 6310SP, Space Rocket Propulsion Demonstration; Project 5034, efforts transfer to PE 0603203F, Advanced Aerospace Sensors, Project 6388SP, Advanced Space Sensors; and Project 5062, efforts transfer to PE 0603211F, Aerospace Technology Development/Demonstration, Project 6399SP Advanced Structures Space Vehicles, in order to more effectively manage and provide oversight of the efforts.
0603605F	Advanced Weapons Technology	In FY 2007, efforts will transfer from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5031, Advanced Optics and Laser Space Tech, to this project in order to more effectively manage and provide oversight of the efforts. In FY2007, this is a new start.

BUDGET ACTIVITY #4: ADVANCED COMPONENT DEVELOPMENT AND PROTOTYPE (Volume 2)

0603851F	ICBM - DEM/VAL	In FY 2007 and beyond, Project 1024 ICBM Command & Control (C2) Applications is discontinued.
0604400F	Joint Unmanned Combat Air System (J-UCAS)	In FY2007-11, the J-UCAS program is being terminated and $1,830.5M is being realigned to PE0604402N.
0604855F	Operationally Responsive Launch	In FY 2007 this PE is being closed and the effort transferred to PE 0604857F, Operationally Responsive Space. The new PE recognizes the broader scope of not just responsive launchers, but also satellites and ranges, necessary for a responsive space system.

0604857F	Operationally Responsive Space	In FY 2007, this is a new PE. The funding is being transferred from PE 0604855F, Operationally Responsive Launch. This new PE recognizes the broader scope of not just responsive launchers, but also satellites and ranges, necessary for a responsive space system. In FY 2007, the Affordable Responsive Spacelift (ARES) effort in Project 64A016 and the Tactical Satellite (TacSat) effort in Project 64A015 are new starts to meet some of the requirements of the Operationally Responsive Space Analysis of Alternatives.

BUDGET ACTIVITY #5: SYSTEM DEVELOPMENT AND DEMONSTRATION (SDD) (Volume 2)

0207434F	Link 16 Support and Sustainment	In FY2007 and out, funding for the Single Integrated Air Picture program (SIAP) (currently residing in PE 0207434F and PE 0207443F), will be moved to PE 0207451F.
0207443F	Family of Interop Operational Pic (FIOP)	In FY2007 and out, funding for the Single Integrated Air Picture program (SIAP) (currently residing in PE 0207434F and PE 0207443F), will be moved to PE 0207451F.
0207451F	Single Integrated Air Picture (SIAP)	In FY2007, this is a new PE. All Single Integrated Air Picture (SIAP) funds from PE 0207443F Project #655187 and PE 0207434F Project #655050 were transferred to consolidate Air Force SIAP funds.
0604012F	Joint Helmet Mounted Cueing System (JHMCS)	In FY2007 and beyond, funds transferred from PE 0604012F to PE 0207170F.
0604240F	B-2 Advanced Technology Bomber	In FY2007, the B-2 Mode S/5 Identification Friend or Foe (IFF) and the Proximity Sensor Logic Unit (PSLU) are new start programs.
0604261F	Personnel Recovery Systems	In FY2007, this is a new start.
0604280F	Joint Tactical Radio Systems (JTRS)	In FY2007, Project No. 5068, Joint Tactical Radio Systems (JTRS) efforts were transferred from PE 0604280F to PE 0604280A, Joint Tactical Radio Systems (JTRS) in order to support the revised JTRS program development acquisition strategy. Refer to PE 060280A for all updates on acquisition strategy contracts and schedules. Only FY 2005 and FY 2006 actuals have been updated within this display.
0604421F	Counterspace Systems	In FY2007, this program includes a new start effort.
0604425F	Space Situation Awareness Systems	In FY 2007 this is a new PE. These projects transferred from PE 0305910F, Spacetrack, to reflect evolution of space surveillance to the Space Situation Awareness construct.
0604429F	Airborne Electronic Attack	In FY 2007, Project 655193, B-52 Stand-Off Jammer, is terminated.
0604443F	Alternative Infrared Satellite System (AIRSS)	In FY 2007, this is a new PE. In FY 2007, Project Number 65A020, Alternative Infrared Satelitte System includes new start efforts.
0604617F	Agile Combat Support	In FY2007, this program includes a new start effort.

0604618F	Joint Direct Attack Munition	In FY2007, this program includes a new start effort.
0604706F	Life Support Systems	In FY2007, this program includes new start efforts.
BUDGET ACTIVITY #6: RDT&E MANAGEMENT SUPPORT (Volume 2)		
0604759F	Major T&E Investment	In FY 2007, Project 4597, Air Force Test Investments, includes new start efforts
BUDGET ACTIVITY #7: OPERATIONAL SYSTEM DEVELOPMENT (Volume 3)		
0207170F	JHMCS	In FY2007 and beyond, funds transferred from PE 0604012F to PE 0207170F. This is a new start.
0207418F	TAC Airborne Control System	In FY 2007 this is the first time this program element (PE) has had Research, Development, Testing and Evaluation (RDT&E) funds, Project Number 5234, Tactical Air Control Party (TACP) Support, includes new start efforts.
0303131F	Minimum Essential Emergency Communications Network (MEECN)	In FY2007, this program includes a new start effort.
0303140F	Information Systems Security Program	In FY2007, former Project 674861, AF Electronic Key Management System - Key Management Infrastructure (AFEKMS-KMI), is being split to properly reflect the Joint KMI Program as a next-generation system rather than an upgrade to the current EKMS. The AFEKMS stays in BPAC 674861; the AF KMI moves to the new BPAC 675231. However, since the transformational key generation/key provisioning capability will not be built into KMI until Capability Increment (CI)-3, EKMS will continue to provide this capability via a number of temporary interfaces created for that purpose.
0304260F	Airborne SIGINT Enterprise (JMIP)	In FY2007, BPACs 5180, 5182, and 5186 are new starts. This PE began in FY06 and combines signals intelligence (SIGINT) development efforts previously being accomplished in multiple USAF PEs. The funds have been distributed among all seven Airborne SIGINT Enterprise (ASE) projects based on the development priorities established by the USAF SIGINT Capabilities Working Group in order to build a total SIGINT capability. This program element will participate in the development, testing, and implementation of international standards (to include NATO standardization agreements) to ensure joint, allied, and coalition interoperability. All funds in Compass Bright are 3600 RDT&E. The source for these funds was the redistribution of SIGINT funds moved into the ASE PE from other USAF SIGINT projects as explained in the R2. For BPAC 675180, these funds will be split between the RIVET JOINT, COMBAT SENT, and COBRA BALL programs.
0305173F	Space & Missile Test & Evaluation Center	In FY 2007, all funding from BPAC 4992 was transferred to new BPAC A014 - this re-name better reflects focus of efforts.

0305910F	Spacetrack	In FY 2007 these projects all transferred to PE 0604425F, Space Situation Awareness Systems, to reflect evolution of space surveillance to the Space Situation Awareness construct, with two exceptions: Project 67A008 transferred to PE 0305940F, Space Situation Awareness Operations, for the same reason, and Project 67A009 was terminated in FY 2006 rather than transferred to another PE.
0305917F	Space Architect	In FY 2007 these efforts transferred to PE 0305924F, National Security Space Office, to reflect the name of the office created by the merger of the National Security Space Architect with other organizations.
0305924F	National Security Space Office	In FY 2007 this is a new PE. These efforts transferred from PE 0305917F, Space Architect, to reflect the name of the office created by the merger of the National Security Space Architect with other organizations.
0305940F	Space Situation Awareness Operations	In FY 2007 this is a new PE. This project transferred from PE 0305910F, Spacetrack, to reflect evolution of space surveillance to the new Space Situation Awareness construct.
0401219F	KC-10S	In FY2007, this program includes a new start effort.
0401839F	Airlift/Other Tactical Data Link	In FY2007, this is a new start.

The following are Program Elements not providing RDT&E exhibits due to classification:

0101815F	Advanced Strategic Programs
0207248F	Special Evaluation Program
0207424F	Evaluation and Analysis Program
0207591F	Advanced Program Evaluation
0208160F	Technical Evaluation System
0208161F	Special Evaluation System
0304311F	Selected Activities
0603801F	Special Programs
0101314F	Night Fist
0304312F	Special Applications Program
0207433F	Advanced Program Technology

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PROGRAM ASSESSMENT

PROGRAM
View Similar Programs

Defense Applied Research Program

This program supports scientific study of physical, biomedical, behavioral or other phenomena to determine the means by which a particular military need may be met. This work is a little more advanced and applied than the basic research from which it may arise.

RATING
What This Rating Means

PERFORMING

Moderately Effective

- **Program purpose and design are clear.** The purpose is to support quality science with potential application to the defense mission. The Department has established methodical processes for setting program goals and for reviewing progress.
- **Reviews of the program by external review panels are not independent of program officials.** Some reviewers are government employees with financial associations to the program areas under review.
- **A large part of the program is executed either without the benefit of military or scientific expertise in choosing the funded work or without allowing the applications process to be open to all capable researchers.** Earmarking of projects in the program has increased in the recent past and has led to these problems.

IMPROVEMENT PLAN
About Improvement Plans

We are taking the following actions to improve the performance of the program:

- Ensuring that adequate funding exists to carry promising basic research results through the applied research phase.
- Changing the expert evaluation process to use fully independent review panels in assessing the performance of the program.
- Working with the research community and Congress to explain the need to limit claims on research grant funds to proposals that independently can meet the standards of a strict merit-review process.

LEARN MORE

- **Details and Current Status of this program assessment.**
- How all Federal programs are assessed.
- Learn more about Defense Applied Research Program.

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PROGRAM ASSESSMENT

PROGRAM
View Similar Programs

Defense Basic Research

This program supports scientific study and experimentation to increase fundamental knowledge in the physical, engineering, environmental and life sciences of potential importance to the defense mission. The program is carried out primarily through grants to universities and non-profit organizations.

RATING
What This Rating Means

PERFORMING

Effective

- **The program has clear purposes.** It helps develop technologies that provide options for new weapons, helps prevent technological suprise by adversaries and develops new scientists who will contribute to the DoD mission in the future.
- **The program is reviewed regularly by technically capable outside expets, who recommend improvements they believe should be implemented.** The experts indicate that the work is of overall high quality.
- **Research earmarks have increased dramatically in the past 15-20 years.** Such projects contribute less than typical projects to meeting the Department's mission, as they don't have to be screened for relevance or quality, and cost more to administer. Earmarks also reduce incentives for other projects to perform to peak potential, as non-earmarked projects encounter less competition for funding.

IMPROVEMENT PLAN
About Improvement Plans

We are taking the following actions to improve the performance of the program:

- Emphasizing the use of independent review panels in assessing the performance of the program.
- Working with the research community and Congress to explain the need to limit claims on research grant funds to proposals that independently can meet the standards of a strict merit-review process.

LEARN MORE

- **Details and Current Status of this program assessment.**
- How all Federal programs are assessed.
- Learn more about Defense Basic Research.

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PROGRAM ASSESSMENT

PROGRAM
View Similar Programs

Defense Small Business Innovation Research/Technology Transfer

This program uses funding set aside specifically for small businesses to investigate the potential for new technologies to help meet the Department's mission and funds the early stage of development of such technologies by small businesses.

RATING
What This Rating Means

NOT PERFORMING

Results Not Demonstrated

- **Provides funds to small businesses, but has poor controls on unproductive spending.**
- **Continues to provide funding to companies with track records of poor performance.**
- **Overestimates commercial successes resulting from Federal support by counting additional investment on par with product sales as measures of success.** Product sales are the ultimate measure of success in the marketplace.

IMPROVEMENT PLAN
About Improvement Plans

We are taking the following actions to improve the performance of the program:

- Tightening eligibility requirements for accepting proposals from companies and individuals that repeatedly fail to sell resulting products in the marketplace.
- Changing the way companies' past performance is assessed to ensure that it more closely matches the intent of the law (Section 638 of Title 15, USC) that the program support product commercialization.
- Seeking to get highly successful awardees to enter the mainstream of Defense contracting.

LEARN MORE

- **Details and Current Status of this program assessment.**
- How all Federal programs are assessed.
- Learn more about Defense Small Business Innovation Research/Technology Transfer.

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PROGRAM ASSESSMENT

PROGRAM

View Similar Programs

National Security Space Weather Programs

The weather satellite programs reviewed include current operational systems and the next generation satellites under development. Weather satellites collect global high resolution visible and thermal cloud imager and other meteorological/oceanographic date supporting DoD forces and civil agencies.

RATING

What This Rating Means

PERFORMING

Adequate

- **The National Security Weather Satellite Programs are adequately meeting their mission requirements.** The current weather satellite program continues to provide the DoD assured access to weather data remote areas such as Afghanistan and Iraq.

- **The next-generation weather satellite system being developed jointly with DOC, has experienced some development challenges and cost overruns, and is currently under review by the DoD and DOC.** However, this new program will fully meet military and civil user requirements and significantly improve weather forecasting and climate prediction in the future.

IMPROVEMENT PLAN

About Improvement Plans

We are taking the following actions to improve the performance of the program:

- Working with Commerce to address programmatic problems and analyzing system and architectural replan options based on findings from various studies provided by the program office.

LEARN MORE

- **Details and Current Status of this program assessment.**
- How all Federal programs are assessed.
- Learn more about National Security Space Weather Programs.

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EXPECT FEDERAL PROGRAMS TO PERFORM WELL, AND BETTER EVERY YEAR.

PROGRAM ASSESSMENT

PROGRAM
View Similar Programs

Space Launch

This set of programs provides the United States with satellite launch capability. The systems includes the launch vehicles, ground infrastructure and launch range capability to support satellite launches and other national security space operations.

RATING
What This Rating Means

PERFORMING
Adequate

- **The assessment found that the Evolved Expendable Launch Vehicle (EELV) program has demonstrated good progress in achieving its annual and long-term goals.** The EELV has performed flawlessly to date, with a 100% launch success rate.

- **New independent evaluations will need to be accomplished in the next cycle to evaluate the effectiveness of achieving cost, schedule and performance goals for various space launch programs.**

IMPROVEMENT PLAN
About Improvement Plans

We are taking the following actions to improve the performance of the program:

- Continue monitoring milestones for schedule compliance to ensure programmatic adjustments can be made in a timely and efficient manner without disrupting planned satellite launches.
- Ensure the satellite launch programs are flexible enought to respond to changing conditions, while maintaining the necessary capabilities described in National Space Transportation policy.

LEARN MORE

- **Details and Current Status of this program assessment.**
- How all Federal programs are assessed.
- Learn more about Space Launch.

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PE NUMBER: 0601102F
PE TITLE: Defense Research Sciences

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 01 Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	246.414	241.436	250.232	239.586	256.843	261.460	266.577	Continuing	TBD
2301	Physics	25.701	25.158	27.850	24.751	24.935	25.342	26.832	Continuing	TBD
2302	Solid Mechanics and Structures	13.009	14.139	17.093	15.682	15.959	16.313	16.646	Continuing	TBD
2303	Chemistry	30.465	31.067	32.860	29.562	29.581	29.981	30.081	Continuing	TBD
2304	Mathematics and Computing Sciences	25.147	26.802	31.318	30.980	29.612	30.166	30.685	Continuing	TBD
2305	Electronics	25.646	30.360	33.835	33.163	36.606	37.258	37.855	Continuing	TBD
2306	Materials	17.850	17.753	20.302	20.007	20.418	20.774	21.102	Continuing	TBD
2307	Fluid Mechanics	27.618	12.879	12.070	11.698	11.942	12.173	12.384	Continuing	TBD
2308	Propulsion	16.524	21.729	18.347	18.058	18.477	18.821	19.140	Continuing	TBD
2311	Space and Information Sciences	29.553	30.488	27.005	25.489	25.368	25.829	26.255	Continuing	TBD
2312	Biological Sciences	9.437	9.687	10.052	10.501	10.774	10.974	11.159	Continuing	TBD
2313	Human Performance	13.183	13.687	10.804	10.650	14.725	15.014	15.281	Continuing	TBD
4113	External Research Programs Interface	12.281	7.687	8.696	9.045	18.446	18.815	19.157	Continuing	TBD

Note: Funds for FY 2006 Congressionally-directed Fully-Integrated Solar-Powered Interior Lighting Technology in the amount of $1.0 million are in the process of being moved to PE 0602102F, Materials, from PE 0601102F, Defense Research Sciences, for execution. Funds for FY 2006 Congressionally-directed National Aerospace Leadership Initiative in the amount of $21.0 million are in the process of being moved to PE 0601102F, Defense Research Sciences, from PE 063211F, Aerospace Technology Development and Demonstration, for execution. Funds for FY 2006 Congressionally-directed Notre Dame Center for Flow Physics and Control in the amount of $3.0 million are in the process of being moved to PE 0601102F, Defense Research Sciences, from PE 062203F, Aerospace Propulsion, for execution.

(U) A. Mission Description and Budget Item Justification

This program consists of extramural research activities in academia and industry along with in-house investigations performed in the Air Force Research Laboratory. This program funds fundamental broad-based scientific and engineering research in areas critical to Air Force weapon systems. Projects are coordinated through the Defense Reliance process to harmonize efforts, eliminate duplication, and ensure the most effective use of funds across the Department of Defense. All research areas are subject to long-range planning and technical review by both Air Force and tri-Service scientific planning groups. Note: In FY 2006, Congress added $1.0 million for Fully-Integrated Solar-Powered Interior Lighting Technology; $0.75 million for Non-Lethal Stunning/Immobilizing Weapons; $1.4 million for Corrosion Protection of Aluminum Alloys Used in Aircraft; $1.8 million for Nanophotonic Components; $2.0 million for National Hypersonic Research Center; $5.0 million for Coal-Based Fuel; $1.0 million for Griffith Observatory's Planetarium; $4.6 million for Network Information and Space Security Center; and $3.5 million for Virtual Operation for Unmanned Aerial Vehicles. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation. Through this program, the Air Force invests in research directed toward increasing knowledge and understanding in those fields of science and engineering related to long-term national security needs.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	252.113	223.894	245.595
(U)	Current PBR/President's Budget	246.414	241.436	250.232
(U)	Total Adjustments	-5.699	17.542	
(U)	Congressional Program Reductions	0.000	-0.016	
	Congressional Rescissions	-0.204	-3.492	
	Congressional Increases	0.000	21.050	
	Reprogrammings	-2.804		
	SBIR/STTR Transfer	-2.691		

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 01 Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT NUMBER AND TITLE: 2301 Physics

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2301 Physics	25.701	25.158	27.850	24.751	24.935	25.342	26.832	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

Physics basic research seeks to enable revolutionary advances in and expand the fundamental knowledge supporting laser technologies, sensing, and imaging capabilities, communications and navigational systems, fuels and explosives, and directed energy weapons that are critical to the Air Force. The primary areas of research investigated by this project are laser and optical physics; electro-energetics (includes plasma) physics; atomic, molecular, and particle physics; and space sensors and imaging physics.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Investigate regulated, broad-spectrum, variable-energy lasers, laser arrays, and multi-aperture adaptive optics.	8.144	8.237	9.573
(U) In FY 2005: Continued investigating physical properties of lasers to enable, monitor, and regulate tunable, wide wavelength band lasers (e.g., solid state, free electron, fiber). Investigated novel tomographic and optical techniques tied to large, multi-aperture, adaptive telescopes and radars. Expanded studies of novel laser micro-and nano-machining techniques and their applications to new materials with desirable space and electronic properties. Explored laser applications for infrared countermeasures.			
(U) In FY 2006: Continue investigating physical properties of lasers to enable, monitor, and regulate tunable, wide wavelength band lasers. Continue investigating novel tomographic and optical techniques tied to large, multi-aperture, adaptive telescopes and radars. Explore use of directed energy beams for direct-write materials-processing techniques that offer new microelectronics and micromechanics fabrication and packaging capabilities. Continue to examine laser applications for infrared countermeasures.			
(U) In FY 2007: Further investigate new laser materials and configurations to enable efficient, high power, and widely wavelength tunable lasers. Investigate arrays of micro-discharges for laser devices and pumps, as well as other intense light source applications. Further explore use of directed energy beams for direct-write materials processing techniques that offer new microsystems fabrication and packaging capabilities. Continue to study semiconductor laser and nonlinear optical devices for improved application to infrared countermeasures.			
(U)			
(U) MAJOR THRUST: Explore high-energy, electro-energetic device concepts and manipulate atomic and molecular properties, atomic collision processes, and atomic, molecular, ionic, and radiation interactions to improve explosives and fuels, advance directed energy systems, enhance surveillance, provide superior communications, and improve precision navigation.	10.964	11.056	13.520
(U) In FY 2005: Continued to characterize interactions of atoms and molecules in strong electromagnetic fields for laser			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2301 Physics**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	applications. Examined techniques for precision measurement of atomic and molecular properties, atomic collision processes, and fundamental interactions between atoms, molecules, ions, and radiation. Explored advances in high-resolution spectroscopy via the trapping and cooling of atoms and ions. Continued exploring dynamic molecular interactions in combustion and high energy density propellants. Continued examining materials, surfaces, and air breakdown in the presence of strong electric and sub-meter wave fields. Continued plasma physics studies in the areas of all-electric military platforms, high-bandwidth communications, and advanced long-distance covert surveillance. Continued probing the effects of short-pulse intense electric fields on cells and organelles.			
(U)	In FY 2006: Continue to characterize interactions of atoms and molecules in strong electromagnetic fields. Continue to examine techniques for precision measurement of atomic and molecular properties, atomic collision processes, and fundamental interactions between atoms, molecules, ions, and radiation. Continue exploring dynamic molecular interactions in combustion and high energy density propellants. Continue studies on the stunning effects of short-pulse, high intensity electric fields. Continue explorations of high power, high frequency device concepts and studies of new compact pulsed power technologies. Explore use of electron beam generated microwave for, high-bandwidth communications, advanced long-distance covert surveillance, electronic countermeasures, and directed energy weapons. Expand studies of new technologies for generating very high current-density electron beams under high vacuum conditions for new generations of high power microwave weapons concepts. Use atomic physics to study overlap research areas between atomic physics and condensed matter physics (e.g., the study of many body phenomena).			
(U)	In FY 2007: Continue characterizing the interactions of atoms and molecules in strong electromagnetic fields. Continue to examine techniques for precision measurement of atomic and molecular properties, atomic collision processes, and fundamental interactions between atoms, molecules, ions, and radiation. Continue exploring dynamic molecular interactions in combustion and high energy density propellants. Continue studies on electro-energetic concepts related to non-lethal weaponry. Continue explorations of high power, high frequency electromagnetic device concepts and studies of new compact pulsed power technologies. Continue to explore the use of electron beam generated microwaves for high-bandwidth communications, advanced long-distance covert surveillance, electronic countermeasures, and directed energy weapons. Investigate ultra-high current density cathode concepts. Initiate advanced modeling and simulation of electro-energetic phenomena. Continue study of overlap research areas between atomic physics and condensed matter physics. Resolve basic scientific issues blocking realization of electromagnetic launch concepts.			
(U)				
(U)	MAJOR THRUST: Advance technologies for space sensors, imaging, identification, and tracking methods, and effective space situational awareness.	4.045	4.139	4.757

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2301 Physics**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2005: Probed effects of atmospheric and space environments on sensors and energy (i.e., information) propagation. Identified, characterized, and modeled parameters enabling remote sensing, locating, and precision tracking of objects in and from space. Evaluated tools and enhanced system interactions for enabling effective space situational awareness.			
(U)	In FY 2006: Continue studying fundamental issues of atmospheric and space environments concerning remote sensing, including propagation, image formation, and image recovery processes. Continue to identify, characterize, and model parameters enabling remote sensing, locating, and precision tracking of objects, particularly from space and of space objects from the ground.			
(U)	In FY 2007: Continue studying fundamental issues that affect remote sensing, including propagation, image formation, and image recovery processes. Continue to identify, characterize, and model parameters enabling remote sensing, locating, and precision tracking of objects, particularly from space and of space objects from the ground. Further study of environmental effects on sensors and sensor systems and of the effects of the medium through which the signal propagates.			
(U)				
(U)	CONGRESSIONAL ADD: Non-lethal Stunning/Immobilizing Weapons	0.490	0.740	0.000
(U)	In FY 2005: Continued accelerated efforts in conducting fundamental scientific investigations in non-lethal stunning and immobilizing weapons research.			
(U)	In FY 2006: Contintue to investigate non-lethal weaponry utilizing radio frequency/microwave radiation.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Microwave Vacuum Electronics Power Research Initiative	2.058	0.000	0.000
(U)	In FY 2005: Re-established a joint industry-university program for research into Microwave Vacuum Engineering (MVE) and High Power Microwave (HPM) technology.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Fully-Integrated Solar-Powered Interior Lighting Technology	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Fully-Integrated Solar-Powered Interior Lighting Technology.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	25.701	25.158	27.850

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2301 Physics**

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602203F, Aerospace Propulsion.									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0602601F, Space Technology.									
(U) PE 0602605F, Directed Energy Technology.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 01 Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT NUMBER AND TITLE: 2302 Solid Mechanics and Structures

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2302 Solid Mechanics and Structures	13.009	14.139	17.093	15.682	15.959	16.313	16.646	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

Solid mechanics and structures basic research aims to improve load-bearing performance of air and space structures through the prediction and control of multi-scale phenomena ranging from micro-level deformation and fracture of materials to the structural dynamics of large platforms. The goals are cost-effective development and safe, reliable operation of superior Air Force weapon and defensive systems. Fundamental knowledge of "multi-functional" structures with smart materials, sensors, actuators, and control systems integrated to accomplish damage control, thermal management, vibration reduction, and reconfigurable shapes. Research topics include: the modeling of non-linear static/dynamic behavior of structures; mechanical reliability of micro-devices; design of multi-functional materials; mechanical behavior of nano-materials; and composite materials for structures.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Explore the integration of advanced materials (including nano-materials) and devices into turbine engines, air vehicles, space systems, and other weapon systems, and develop new mechanics criteria for system integration.	6.165	6.986	8.071

(U) In FY 2005: Advanced research in the mechanics of materials and devices, with continued focus in the areas of multi-functional design, diagnostics, prognostics, self-healing, micro-/nano-mechanics, autonomics, thermal management, and energy harvest. Investigated methods to combine information technology and multi-scale modeling in the design of new materials and structures. Continued nano-mechanics research to promote the transition from continuum mechanics to atomistic modeling.

(U) In FY 2006: Continue research in the areas of diagnostics, prognostics, self-healing, micro-/nano-mechanics, autonomics, and thermal management to enable safer and more durable aerospace structures with improved performance characteristics. Continue research on the autonomics to include the integration of energy harvesting/storage functions into load-bearing structures. Support research to develop the fundamental knowledge required to design and manufacture multi-functional aerospace material systems and devices and to predict their performance and structural integrity. Develop and exploit methods that combine information technology and modeling in the design of new material systems and devices at multiple scales.

(U) In FY 2007: Expand research in the areas of diagnostics, prognostics, self-healing, micro-/nano-mechanics, autonomics, thermal management, atomic-scale modeling, and energy harvesting to enable safer and more durable aerospace structures with improved performance characteristics. Further develop the fundamental knowledge required to design and manufacture multi-functional aerospace material systems and devices and to predict their performance and structural integrity. Continue developing and exploiting methods that combine information technology and modeling in the design of new material systems and devices at multiple scales.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2302 Solid Mechanics and Structures

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	MAJOR THRUST: Analyze structural fatigue and mechanics, adaptive structures, and material properties to improve the design, robustness, and performance of air and space systems to include multi-mission unmanned aerial vehicles (UAVs).	6.844	7.153	9.022
(U)	In FY 2005: Continued to examine and analyze structural mechanics to include fatigue, integrity, high cycle metal fatigue, and other material aging phenomena. Investigated metal fatigue-generation caused by the vibration of compressors and turbine blades. Continued assessing means and models to identify, evaluate, and mitigate material degeneration and degradation. Continued developing novel system techniques to analyze vehicle integrity. Advanced models of interaction between UAV structural motion and high-speed aerodynamics. Characterized distributed sensor and actuator systems. Explored the mechanical and dynamic behavior of micro-/nano-scale structures.			
(U)	In FY 2006: Explore methods for constructing and modeling morphing structures that broaden system operational capabilities. Develop novel actuation devices and materials for applications such as micro-UAV aircraft and space structures. Continue to investigate metal fatigue-generation caused by the vibration of compressors and turbine blades. Develop structural health monitoring techniques and systems. Continue to explore the mechanical and dynamic behavior of micro-/nano-scale structures. Explore the exploitation of nonlinear phenomena, such as structural deformation and aero-elastic effects in novel structural applications.			
(U)	In FY 2007: Continue to explore novel methods for constructing and modeling morphing structures that broaden system operational capabilities. Continue development of novel actuation devices and materials for applications such as micro-UAV aircraft and space structures. Utilize acquired knowledge of material behavior in aerospace structure to develop system lifetime prognosis methodologies. Continue development of structural health monitoring techniques and systems and exploration of mechanical and dynamic behavior of micro-/nano-scale structures. Continue investigation of nonlinear phenomena, such as structural deformation and aero-elastic effects in novel structural applications.			
(U)	Total Cost	13.009	14.139	17.093

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602102F, Materials.

(U) PE 0602201F, Aerospace Flight Dynamics.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2302 Solid Mechanics and Structures**

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

(U) PE 0602202F, Human Effectiveness Applied Research.

(U) PE 0602203F, Aerospace Propulsion.

(U) PE 0603211F, Aerospace Structures.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 01 Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE: 2303 Chemistry	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2303 Chemistry	30.465	31.067	32.860	29.562	29.581	29.981	30.081	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

Chemistry basic research seeks bold innovations in understanding, modeling, and controlling chemical reactions for developing new materials, improving synthesis of existing materials, controlling energy flow and storage, and regulating interactions between materials and their environments. Studies expand fundamental understanding of properties regulating the chemical dynamics and energy transfer processes that foster advances in laser weaponry and allow predictions of the infrared, optical, and radar signatures of reaction products and intermediates that advance reliable target assessment and tracking. Critical research topics include: novel synthesis and characterization of lower cost, higher performance functional and structural materials, electronics, and photonic materials; nano-structures; electromagnetics; and conventional weaponry. Focused investigations include bio-derived mechanisms for lifetime extension of materials and catalysis, and the exploration of atomic and molecular surface interactions that limit performance of electronic devices, compact power sources, and lubricant materials. Primary areas of research include molecular reaction dynamics; theoretical chemistry; polymer chemistry; biophysical mechanisms; and surface and interfacial science.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Research and characterize molecular dynamics, reaction mechanics/interactions, and theoretical chemistry to model, predict, control, and exploit atomic and molecular energetics for advanced fuels, munitions, and countermeasure techniques.	13.064	13.118	14.947

(U) In FY 2005: Explored ion and plasma chemistry for combustion control applications. Investigated nano-structure concepts and models for propulsion and munition reactive energetics. Continued modeling chemically reacting flows associated with hypersonic vehicles, hydrocarbon-fueled scramjets, and combined-cycle engines. Continued to optimize chemical properties enriching high energy lasers, advancing high-energy, high density fuels and materials, enhancing space lift, and extending time-on-orbit/station.

(U) In FY 2006: Utilize theoretical chemistry to predict promising new chemicals of interests to the Air Force and to guide their efficient synthesis. Enhance efforts to develop higher performance, less sensitive nano-scale energetic materials for applications in munitions and propellants. Support research to understand, predict, and control the reactivity and flow of energy in molecules to improve exhaust signature detection and control capabilities, to develop new high-energy, high density chemicals for propellants and propulsion systems and to develop new high-energy chemical laser systems.

(U) In FY 2007: Continue to utilize theoretical chemistry to predict promising new chemicals of interests to the Air Force and to guide their efficient synthesis. Continue to advance research to understand, predict, and control the reactivity and flow of energy in molecules to improve exhaust signature detection and control capabilities, to develop new high-energy, high density chemicals for propellants and propulsion systems, and to develop new high-energy chemical laser systems. Continue efforts to develop higher performance, less sensitive nano-scale energetic materials

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2303 Chemistry

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	for applications in munitions and propellants.			
(U)				
(U)	MAJOR THRUST: Enhance fundamental understanding of polymer chemical structures, reactivity, molecular engineering, processing controls, and materials technologies to develop advanced organic and matrix composites aimed at improving Air Force systems performance and life spans.	8.654	9.537	10.388
(U)	In FY 2005: Designed and characterized conductive polymers, photonic polymers, nano-structures, and bio-inspired polymers. Evaluated nano-composite structures and mechanical properties for potential applications under harsh space environments. Focused on enhancing optical nonlinearity of organic molecules for laser protection applications.			
(U)	In FY 2006: Continue to focus on enhancing optical nonlinearity for laser protection applications. Exploit nanotechnological techniques to develop compact solar arrays, fuels cells, and power storage systems to provide lightweight power sources for space assets. Exploit photorefractive polymer as a medium for wavefront correction in optical communication and imaging.			
(U)	In FY 2007: Continue to utilize nanotechnology to enhance chemical and physical properties of polymers. Continue to exploit photorefractive polymer as a medium for wavefront correction in optical communication and imaging. Continue to explore flexible structures that can provide functions such as sensing, power generation and storage, electronics, and other functionalities for smart skin and multi-functional structures.			
(U)				
(U)	MAJOR THRUST: Expand the fundamental chemistry and physics of surfaces and interfacial processes pertaining to corrosion protection, wear reduction, micro- and nano-assemblies, and power storage for air and space systems.	6.982	7.032	7.525
(U)	In FY 2005: Enhanced theoretical and predictive methods for surface and interfacial chemical processes. Created and characterized novel multi-functional surface structures, coatings, covers, and lubricants. Investigated nano-scale surface structures for enhanced energy-density storage/delivery and chemically directed self-assembled surfaces for sensor, optical, and power applications. Probed electro-chemical behaviors at surfaces and interfacial regions.			
(U)	In FY 2006: Develop theoretical and predictive methods for the fundamental understanding of the structure and reactivity of surfaces and how surfaces interact with their environment at the interface. Investigate phenomena at surface interfaces, including thin film and alloy growth, friction and wear, lubrication, corrosion and degradation, sensing, electrochemical energy storage, and electrochemically induced reaction products and kinetics. Continue to create and characterize novel multi-functional surface structures, coatings, covers, and lubricants. Continue to investigate nano-scale surface structures and systems for electronic, power, and sensing applications.			
(U)	In FY 2007: Continue developing theoretical and predictive methods for the fundamental understanding of the structure and reactivity of surfaces and how surfaces interact with their environment at the interface. Continue to			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2303 Chemistry

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	investigate phenomena at surface interfaces, including friction and wear, lubrication, corrosion and degradation, sensing, electrochemical energy storage, and electrochemically induced reaction products and kinetics. Continue to create and characterize novel multi-functional surface structures, coatings, covers, and lubricants. Investigate novel biophysical mechanisms for catalysis and survivability in compact electronic, power, and sensing applications.			
(U)				
(U)	CONGRESSIONAL ADD: Corrosion Protection of Aluminum Alloys Used in Aircraft	1.765	1.380	0.000
(U)	In FY 2005: Conducted research to enable, enhance, and exploit environmentally benign cost-effective coating systems for the protection and prevention of corrosion of aluminum alloys used in air and space vehicles.			
(U)	In FY 2006: Continue study of environmentally benign cost-effective coating systems for the protection and prevention of corrosion to aluminum alloys.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	30.465	31.067	32.860

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602102F, Materials.									
(U) PE 0602203F, Aerospace Propulsion.									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0602601F, Space Technology.									
(U) PE 0602602F, Conventional Munitions.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 01 Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE: 2304 Mathematics and Computing Sciences	

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2304	Mathematics and Computing Sciences	25.147	26.802	31.318	30.980	29.612	30.166	30.685	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

Mathematics and computing sciences basic research develops novel techniques for mathematical modeling and simulation, algorithm development, complex systems control, and innovative analytical and high performance computing methods for air and space systems. Basic research provides fundamental knowledge enabling improved performance and control of systems and subsystems through accurate models and computational tools, artificial intelligence, and improved programming techniques and theories. The primary areas of research investigated by this project are dynamics and control, physical mathematics and applied analysis, optimization and discreet mathematics, computational mathematics, and electromagnetics.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Perform dynamics and control research to develop innovative techniques for design and analysis of control systems enhancing capabilities and performance of advanced air and space systems.	7.645	8.168	9.655

(U) In FY 2005: Advanced research on cooperative control in dynamic, uncertain, adversarial environments with applications to swarms of smart munitions, unmanned aerial vehicles (UAVs), and constellations of small satellites. Further developed control methodologies to improve non-equilibrium behavior of complex, unsteady fluid systems with applications for combustion, materials processing, and agile autonomous flight. Continued to probe advances in image processing and sensor technologies for use in UAV controllers, smart munitions, and non-destructive vehicle testing. Investigated the adaptation of bio-inspired sensing systems, controls, and computational methods.

(U) In FY 2006: Further explore cooperative control in dynamic, uncertain, adversarial environments with applications to swarms of smart munitions, UAVs, and constellations of small satellites. Continue examining control methodologies to improve non-equilibrium behavior of complex, unsteady fluid systems with applications for combustion, materials processing, and agile autonomous flight. Improve image processing and sensor technologies for use in UAV controllers, smart munitions, and non-destructive vehicle testing. Continue to investigate the adaptation of bio-inspired sensing systems, controls, and computational methods.

(U) In FY 2007: Advance techniques for design and analysis of cooperative control systems in dynamic, uncertain, adversarial environments with applications to swarms of smart munitions, UAVs, and constellations of small satellites. Continue developing control methodologies to improve non-equilibrium behavior of complex, unsteady fluid systems with applications for combustion, materials processing, and agile autonomous flight. Continue to advance image processing and sensor technologies for use in UAV controllers, smart munitions, and non-destructive vehicle testing. Investigate methods for design and analysis of bio-inspired sensing systems, controls, and computational systems. Develop algorithms for control of and over dynamic, large-scale networks.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2304 Mathematics and Computing Sciences**

(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2005	FY 2006	FY 2007
(U)			
(U) MAJOR THRUST: Research physical mathematics, applied analysis, and electromagnetics.	8.157	8.746	10.161
(U) In FY 2005: Continued research to develop models of physical phenomena to improve simulations and device predictability. Investigated methods to advance target location, recognition and identification, and tracking. Probed the properties of coherently propagating ultra-short laser pulses through the atmosphere. Evaluated algorithms of nonlinear optical effects within fiber lasers and nonlinear optical media. Studied the dynamics of transonic/supersonic/hypersonic platforms and warhead reconfiguration through micro-detonation.			
(U) In FY 2006: Develop more accurate models of physical phenomena to enhance the fidelity of simulations. Investigate properties of coherently propagating ultra-short laser pulses through the atmosphere. Develop algorithms to simulate nonlinear optical effects within fiber lasers and nonlinear optical media. Study the dynamics of transonic/supersonic/hypersonic platforms. Study the design of reconfigurable warheads through suitable placement and of micro-detonators. Improve methods for recognizing and tracking targets and for penetrating coverings or other dispersive media that obscure targets.			
(U) In FY 2007: Continue to develop enhanced models of physical phenomena to advance the fidelity of simulations. Further investigate properties of coherently propagating ultra-short laser pulses through the atmosphere. Continue to develop algorithms to simulate nonlinear optical effects within fiber lasers and nonlinear optical media. Continue to investigate the dynamics of transonic/supersonic/hypersonic platforms. Further study the design of reconfigurable warheads through suitable placement of micro-detonators. Continue to improve methods for recognizing and tracking targets and for penetrating coverings or other dispersive media that obscure targets.			
(U)			
(U) MAJOR THRUST: Conduct research in optimization, as well as computational and discrete mathematics to validate and further advance mathematical methods, algorithms, and modeling and simulation to solve problems and improve designs of advanced Air Force systems.	9.345	9.888	11.502
(U) In FY 2005: Elucidated complex problems in system diagnostics/prognostics, air mobility contingencies, and strategic/tactical planning for battlespace information management. Designed modeling techniques and algorithms for various present day and longer term challenges. Integrated new multi-disciplinary design optimization strategies with high-order, time-accurate solutions for superior design of jet engines, directed energy devices, munitions and penetrators, air and space components, and system health and maintenance systems. Continued computing the simulation uncertainty in non-linear models of aerodynamic flows and structural failure predictions.			
(U) In FY 2006: Continue to solve complex problems in system diagnostics/prognostics, air mobility contingencies, target tracking, and strategic/tactical planning for battlespace information management. Develop innovative methods and algorithms that will improve modeling and simulation capabilities. Continue to integrate new multi-disciplinary			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2304 Mathematics and Computing Sciences**

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	design optimization strategies with high-order, time-accurate solutions for superior design of jet engines, directed energy devices, munitions and penetrators, air and space components, and system health and maintenance systems. Develop mathematical method for solving large or complex problems in logistics, air mobility contingencies, target tracking, and strategic/tactical planning for battlespace information management. Continue computing the simulation uncertainty in non-linear models of aerodynamic flows and structural failure predictions.			
(U)	In FY 2007: Continue to elucidate complex problems in system diagnostics/prognostics, air mobility contingencies, target tracking, and strategic/tactical planning for battlespace information management. Continue to develop innovative methods and algorithms that will improve modeling and simulation capabilities. Continue to integrate new multi-disciplinary design optimization strategies with high-order, time-accurate solutions for superior design of jet engines, directed energy devices, munitions and penetrators, air and space components, and system health and maintenance systems. Continue to develop mathematical method for solving large or complex problems in logistics, air mobility contingencies, target tracking, and strategic/tactical planning for battlespace information management. Continue to enhance uncertainty analysis in non-linear models of aerodynamic flows and structural failure predictions.			
(U)	Total Cost	25.147	26.802	31.318

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602201F, Aerospace Flight Dynamics.									
(U) PE 0602203F, Aerospace Propulsion.									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0602602F, Conventional Munitions.									
(U) PE 0602702F, Command, Control, and Communications.									
(U) PE 0603789F, C3I Advanced									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2304 Mathematics and Computing Sciences**

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

Development.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 01 Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT NUMBER AND TITLE: 2305 Electronics

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2305 Electronics	25.646	30.360	33.835	33.163	36.606	37.258	37.855	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

Electronics basic research enhances the fundamental understanding of electronic materials, devices, and systems to advance Air Force operational capabilities in directed energy weapons, stealth technologies, electronic countermeasures, information and signal processing, and communications. This research enables the development of electronic processes to model and predict the performance of electronic materials, devices, and systems for power generation, optical signal processing, radiation effects, and high-speed signal processing. The goals are to firmly control the complexity and reliability of electronic systems, increase data transmission and information processing speeds, and to improve the security and reliability of electronic information. The primary areas of research investigated by this project are space electronics; semiconductor materials; optoelectronic information processing and memory; and quantum electronic solids.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Assess military space platform unique electronic circuits to increase their reliability, survivability, and functionality while simultaneously reducing component cost, size, and weight in order to improve spacelift, battlefield awareness and control, mission flexibility, and ease of augmentation and upgrade.	6.488	6.534	7.827
(U) In FY 2005: Further investigated effects of intense radio frequency (RF) pulses on electronic circuits and systems. Continued designing, fabricating, and evaluating wide bandgap semiconductor materials to achieve a unique combination of high RFpower output, high efficiency, low noise, robustness, and radiation hardness. Researched scientific barriers to electronic component miniaturization, nano-propulsion and power, smart skins, radiation hardening, and quantum effect electronics. Completed specific Air Force-National Aeronautics and Space Administration (NASA) nano-satellite projects.			
(U) In FY 2006: Conclude major effort to understand RF pulse effects on electronic circuits. Launch new university center of excellence on radiation effects on electronic materials and devices. Transition the results from basic research efforts to baseline gallium nitride bulk material. Closely review and re-vector, where necessary, the new university nanosatellites projects.			
(U) In FY 2007: Investigate novel materials for reconfigurable electronics produced from major review of entire program. Conclude research efforts on wide bandgap gallium nitride materials and devices and transition to major Defense Advanced Research Projects Agency (DARPA) program. Link university nanosatellite projects to key DoD and commercial space interests, and more aggressively seek space launches for the best nanosatellite projects.			
(U)			
(U) MAJOR THRUST: Investigate quantum and optoelectronic materials and devices, memory, and information processing, as well as nano-science for wide-field spectral sensors and critical, high-speed communication systems in order to achieve communications and spectral dominance of the battlespace to include surveillance, target tracking,	13.123	12.770	15.022

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2305 Electronics

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
and target signature identification.			
(U) In FY 2005: Explored unique nonlinear optical and laser materials and fabrication processes for radiation protection, cloaking and tracking, and target signature identification. Explored new concepts, improved efficiencies, and reduced cooling requirements of lasers and detector electronics. Explored ultracompact micro- and nano-photonic structures, chip-scale optical networks, and enhanced data storage (e.g., optoelectronic memory). Probed robust monolithic and miniature terahertz frequency spectrum devices and quantum cascade lasers. Investigated communication network technologies, room temperature ferromagnetic materials, and the interaction of system electronics and sensors with atmospheric and space environments.			
(U) In FY 2006: Investigate nonlinear optical and laser materials, devices, and fabrication processes for radiation protection, cloaking and tracking, and target signature identification. Explore nanoelectronics, nanophotonics, and other advanced optoelectronic and electronic materials and devices for lower power consumption, high-efficiency lasers wavelength-diverse, high sensitivity detectors. Study advanced optical memory technologies for enhanced data storage. Continue to probe robust monolithic and miniature terahertz frequency spectrum devices and quantum cascade lasers. Continue to investigate communication network technologies, room temperature ferromagnetic materials, and the interaction of system electronics and sensors with atmospheric and space environments.			
(U) In FY 2007: Further investigate nonlinear optical and laser materials, devices, and fabrication processes for radiation protection, cloaking and tracking, and target signature identification. Continue to explore nanoelectronics, nanophotonics, and other advanced optoelectronic and electronic materials and devices for lower power consumption, high-efficiency lasers wavelength-diverse, high sensitivity detectors. Further the examination of advanced optical memory technologies for enhanced data storage. Investigate technologies for robust monolithic and miniature terahertz frequency spectrum devices and quantum cascade lasers. Continue to investigate communication network technologies, room temperature ferromagnetic materials, and the interaction of system electronics and sensors with atmospheric and space environments.			
(U)			
(U) MAJOR THRUST: Exploit advances in nanotechnology to support multi-spectral detection technology and chip-scale optical networks. Note: This effort has been broken out from other areas to reflect the increased emphasis being placed on nanotechnology in support of future military capabilities.	0.000	4.000	5.281
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Explore techniques to control growth of self-assembled quantum structures and connections to these structures for multi-spectral image processing. Develop guided wave and free space optoelectronic device technology and methods for their integration to enable chip-scale optical networks that will overcome interconnect problems for military platform networks due to future high-speed information processors. Explore nanophotonic			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2305 Electronics**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	concepts for information processing components and systems.			
(U)	In FY 2007: Develop techniques to control growth of self-assembled quantum structures and connections to these structures for multi-spectral image processing. Continue developing nanoelectronics and nanophotonics for guided wave and free space optoelectronic device technology and method for their integration to enable chip-scale optical networks that will overcome future interconnect problems. Continue exploring nanophotonic concepts for information processing components and systems.			
(U)				
(U)	MAJOR THRUST: Investigate quantum electronic solids phenomena to explore superconducting, magnetic, negative index and nanoscopic materials to produce superconducting tapes for compact power generators and magnets, and for advanced sensors, communications, lightweight antennas, signal processing and ultra-dense memory.	5.056	5.282	5.705
(U)	In FY 2005: Continued examining superconducting quantum computing systems and encryption techniques. Examined methodologies to fabricate high current, high-temperature superconducting cables for enhanced power generation and storage devices. Continued the development of high-temperature magnetic materials with sufficient mechanical strength for use in aircraft electrical systems.			
(U)	In FY 2006: Further examine superconducting quantum computing systems and encryption techniques. Continue to examine methodologies to fabricate high current, high-temperature superconducting materials for enhanced power generation and storage devices. Continue to develop high-temperature magnetic materials for power devices, switches, and bearings in aircraft electrical systems.			
(U)	In FY 2007: Exploit methodologies to fabricate new high current, high-temperature superconducting materials for enhanced power generation and storage devices. Continue search for high-temperature superconductors. Continue to develop high-temperature magnetic materials for power devices, switches, and bearings in aircraft electrical systems. Continue search for three-dimensional negative index materials in the infrared and visible regions, and use these materials to make circuit elements with smaller size and increased functionality.			
(U)				
(U)	CONGRESSIONAL ADD: Quantum Gate	0.979	0.000	0.000
(U)	In FY 2005: Conducted basic research in quantum information technology.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Nanophotonic Components	0.000	1.774	0.000
(U)	In FY 2005: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2305 Electronics

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
(U) In FY 2006: Conduct Congressionally-directed effort for nanophotonic components utilized in electronic materials in a number of aircraft, ship, and soldier systems.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	25.646	30.360	33.835

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0602702F, Command, Control, and Communications.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603789F, C3I Advanced Development.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 01 Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT NUMBER AND TITLE: 2306 Materials

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2306 Materials	17.850	17.753	20.302	20.007	20.418	20.774	21.102	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

Materials basic research enhances the performance, cost, and reliability of structural materials to eliminate reliability issues related to high-temperature strength, toughness, fatigue, and environmental conditions. This research expands fundamental knowledge of material properties that leads to the development of novel materials for airframe, turbine engine, and spacecraft structures. The goals of this project are to develop improved materials for air and space vehicles that provide increased structural efficiency and reliability, increase the operating temperature of engine materials, and further increase thrust-to-weight ratio of engines. Basic research emphasis is on refractory alloys, intermetallics, polymer composites, metal and ceramic matrix composites, advanced ceramics, and new material processing methods. The primary areas investigated by this project are ceramics, non-metallic hybrid composites, and metallic materials.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Perform non-metallic, ceramic, and hybrid materials research to identify and to design new materials and composites with very-high (>1400F) and ultra-high (>2500F) temperature applications. Create inorganic matrix composites, functional materials (including adhesives/epoxies), and hybrid carbon materials to increase the strength, application, and life span of air and space structural materials. (Note: Ramp up due to increased efforts in high temperature nanomaterials and multi-functional materials).	6.439	7.789	9.620

(U) In FY 2005: Optimized the thermal and mechanical stability of oxide ceramic composites for aircraft and engine applications. Identified and designed multi-functional ceramic materials to enable structurally enhanced smart systems. Continued research on very-high and ultra-high temperature nonoxide ceramic materials. Examined innovative concepts for developing higher temperature and more damage-tolerant organic, inorganic, and polymer matrix composites.

(U) In FY 2006: Continue optimizing the thermal and mechanical stability of oxide composites for aircraft and engine applications. Identify new approaches to designing multi-functional structural ceramics materials to enable structurally enhanced smart systems. Investigate high-temperature resistant and lightweight non-oxide ceramic materials. Conduct research on high temperature polymer matrix composites in terms of their durability in harsh environments and its processibility in fabricating high performance structural components. Develop nanomaterials and nanocomposites that will enable reduced system weight and/or size, increased operational lifetime, and multi-functional performance of load-bearing aerospace structures.

(U) In FY 2007: Continue optimizing the thermal and mechanical stability of oxide ceramic composites for aircraft and engine applications. Exploit new approaches to designing multi-functional structural ceramics materials to enable structurally enhanced smart systems for application in extreme environments. Investigate high-temperature resistant and joining methodologies for lightweight ceramic materials. Further examine innovative concepts for developing

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2306 Materials

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	higher temperature and more damage-tolerant organic, inorganic, and polymer matrix composites. Further develop nanomaterials and nanocomposites that will enable reduced system weight and/or size, increased operational lifetime, and multi-functional performance of load-bearing aerospace structures.			
(U)				
(U)	MAJOR THRUST: Research metallic materials and identify relationships between structure (including microstructure), processing, properties, and performance so as to develop affordable and durable metallic systems for advanced engines and aerospace structural applications.	9.157	9.964	10.682
(U)	In FY 2005: Continued exploring and modeling metal matrix composites, refractory metal alloys, and intermetallics for applications at moderate and very high temperatures. Created advanced alloys for multi-functional space systems. Enhanced and broadened computational models by implementing strategies that reduce new structural material maturity time, assess/validate materials design codes, seek integration with design processes, and minimize costs.			
(U)	In FY 2006: Study lightweight structural materials, refractory metals, intermetallic alloys, amorphous alloys and their composites, and micro-laminated materials for sustainable use in aerospace applications. Develop and verify physics-based, quantitative, predictive models that relate processing, chemistry, and structure with properties and performance of metallic materials.			
(U)	In FY 2007: Continue investigating lightweight structural materials, refractory metals, intermetallic alloys, amorphous alloys and their composites, and micro-laminated materials for sustainable use in aerospace applications. Further develop and verify physics-based, quantitative, predictive models that relate processing, chemistry, and structure with properties and performance of metallic materials.			
(U)				
(U)	CONGRESSIONAL ADD: Nanomaterials Research, Nanomanufacturing for Military Applications	2.254	0.000	0.000
(U)	In FY 2005: Conducted basic research in nanomaterials and nanomanufacturing for potential military application.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	17.850	17.753	20.302

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602102F, Materials.									
(U) PE 0602201F, Aerospace Flight Dynamics.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2306 Materials**

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

(U) PE 0602203F, Aerospace Propulsion.

(U) PE 0602500F, Multi-Disciplinary Space Technology.

(U) PE 0602601F, Space Technology.

(U) PE 0603211F, Aerospace Structures.

(U) PE 0708011F, Industrial Preparedness.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 01 Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT NUMBER AND TITLE: 2307 Fluid Mechanics

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2307 Fluid Mechanics	27.618	12.879	12.070	11.698	11.942	12.173	12.384	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

Fluid mechanics basic research advances fundamental knowledge, tools, data, concepts, and methods for improving the efficiency, effectiveness, and reliability of air and space vehicles. The goals are to improve theoretical models for aerodynamic prediction and design, as well as to originate flow control concepts and predictive methods used to expand current flight performance boundaries through enhanced understanding of key fluid flow (primarily high-speed air) phenomena. Basic research emphasis is on turbulence prediction and control, unsteady and separated flows, subsonic/supersonic/hypersonic flows, and internal fluid dynamics. The primary approach is to perform fundamental experimental investigations and to formulate advanced computational methods for the simulation and study of complex flows, prediction of real gas effects in high-speed flight, and control and prediction of turbulence in flight vehicles and propulsion systems. Primary areas of research investigated by this project are unsteady aerodynamics, supersonic and hypersonic aerodynamics, turbulence, and rotating and internal flows characteristic of turbomachinery flows.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Investigate and characterize complex phenomena in supersonic, hypersonic, and unsteady flows to enable and optimize the design of air and space vehicles and flight control systems.	4.862	5.040	5.486
(U) In FY 2005: Explored methods to optimize unsteady, vortex-dominated flows and rapid maneuver control on Unmanned Aerial Vehicles (UAVs). Characterized and modeled hypersonic flows to include boundary layer phenomena, engine inlets, and plasma aerodynamics. Modeled aerothermal and local shock phenomena in hypersonic flows, control concepts, and performance optimization.			
(U) In FY 2006: Further explore methods to optimize unsteady, vortex-dominated flows, and rapid maneuver controls on UAVs. Continue to model and validate unsteady hypersonic flow simulation tools to include boundary layer effects, engine inlets, and plasma aerodynamics. Continue to model aerothermal and local shock phenomena in hypersonic flows with emphasis on control concepts and performance optimization. Explore control strategies for mitigating excessive heat transfer and unsteadiness in hypersonic flows and for abating the effects of highly separated flows.			
(U) In FY 2007: Characterize and model critical phenomena required to predict and control unsteady, vortex-dominated flows and to develop rapid maneuver controls on UAVs. Validate current models and explore higher-fidelity models for unsteady aerodynamics of complex, hypersonic flows to include boundary layer effects, shock-dominated flows (engine inlets), and nonequilibrium effects. Develop control strategy models for mitigating excessive heat transfer and unsteadiness in hypersonic flows and for abating the effects of highly separated flows.			
(U)			
(U) MAJOR THRUST: Expand fundamental knowledge of turbulence in coordinated experimental and computational simulation efforts. Study complex rotating and internal flow phenomena related to turbomachinery and jet engine	5.820	5.868	6.584

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2307 Fluid Mechanics

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
applications with an emphasis on flow control approaches.			
(U) In FY 2005: Evaluated advanced flow control coupling mechanisms in turbulent flows. Used large eddy simulation techniques to probe heat transfer and fluid flow coupling. Modeled unsteady flow control inputs on wings and jet engines to include reduced order, closed-loop flow control demonstrations. Explored aerodynamic mistuning mechanisms in multiple blade row interactions tied to high-cycle fatigue failures. Applied control approaches to flow interactions using measurement and actuation devices compatible with harsh environments.			
(U) In FY 2006: Validate studies of advanced flow control coupling mechanisms in complex, turbulent flows. Validate large eddy simulation techniques to probe heat transfer and fluid flow coupling. Continue to model unsteady flow control inputs on wings and jet engines to include reduced order, closed-loop flow control demonstrations. Further explore and develop models for aerodynamic mistuning mechanisms in multiple blade row interactions tied to high cycle fatigue failures. Further develop control approaches for flow interactions using flow control measurement and actuation devices for harsh environments.			
(U) In FY 2007: Further evaluate advanced flow control coupling mechanisms in complex, turbulent flows, including transient phenomena and time accurate simulation techniques. Evaluate reduced order, closed-loop flow control mechanisms on unsteady flow of complex geometries and jet engines. Further develop large eddy simulation techniques to include heat transfer and fluid flow coupling in preliminary simulations of film cooling flows. Evaluate hybrid computational techniques for accurately modeling turbulent flows. Evaluate coupling between aerodynamic and structural mistuning mechanisms in multiple blade row interactions tied to high cycle fatigue failures. Develop predictive tools for unsteady flow control approaches using sensors and actuators for harsh environments.			
(U)			
(U) CONGRESSIONAL ADD: National Hypersonic Research Center	1.959	1.971	0.000
(U) In FY 2005: Conducted fundamental scientific and engineering research studies at the National Hypersonics Research Center.			
(U) In FY 2006: Expand basic hypersonics research and develop a strong academic program in hypersonics flow physics.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) CONGRESSIONAL ADD: National Aerospace Leadership Initiative	14.977	0.000	0.000
(U) In FY 2005: Established a broad based agenda to reinvigorate America's aerospace research and development and maintain America's competitive leadership in aviation.			
(U) In FY 2006: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2307 Fluid Mechanics**

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
(U) In FY 2007: Not Applicable.			
(U) Total Cost	27.618	12.879	12.070

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602102F, Materials.									
(U) PE 0602201F, Aerospace Flight Dynamics.									
(U) PE 0602203F, Aerospace Propulsion.									
(U) PE 0603211F, Aerospace Structures.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 01 Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT NUMBER AND TITLE: 2308 Propulsion

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2308 Propulsion	16.524	21.729	18.347	18.058	18.477	18.821	19.140	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

Propulsion basic research expounds fundamental knowledge to enable and enhance efficient utilization of energy in airbreathing engines, chemical and non-chemical rockets, and combined cycle propulsion systems for future rapid global reach and on-demand space access. Basic research thrusts include airbreathing propulsion, space power and propulsion, high altitude signature characterization and contamination, propulsion diagnostics, thermal management of space-based power and propulsion, and the synthesis of new chemical propellants. These thrusts can be grouped into reacting flows and non-chemical energetics. Study of reacting flows involves the complex coupling between energy release through chemical reaction and the flow processes that transport chemical reactants, products, and energy. Non-chemical energetics research includes both plasma and beamed-energy propulsion for orbit raising space missions and ultra-high energy techniques for space-based energy utilization. Primary areas of research investigated by this project are space power, propulsion, combustion, and diagnostics.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Research and model space propulsion and power in the areas of chemistry, electronics, miniaturization, and contamination/signature.	7.823	8.358	9.121
(U) In FY 2005: Expanded studies in plasma-based, charged droplet-based, and beamed-energy thrusters. Explored new engine concepts such as pulsed detonation rocket engines. Evaluated unsteady flow coupling and plasma ignition combustion efficiencies and stability. Investigated high altitude signature characterization and spacecraft cross-contamination. Examined Magnetohydrodynamics (MHD) flow control to optimize scramjet flow path performance. Investigated lightweight superconducting magnet capability for MHD flow control of advanced engines.			
(U) In FY 2006: Continue studies in plasma-based, charged droplet-based, and beamed-energy thrusters. Continue studies of pulsed detonation rocket engines and other new engine concepts. Evaluate methods to predict and suppress combustion instabilities. Investigate high altitude plumes signature and contamination. Examine MHD flow control to optimize scramjet flow path performance. Continue to investigate lightweight superconducting magnet capability for MHD flow control of advanced engines.			
(U) In FY 2007: Continue studies in plasma-based, charged droplet-based, and beamed-energy thrusters. Continue to investigate pulsed detonation rocket engines and other new engine concepts. Continue to examine methods to predict and suppress combustion instabilities. Continue to investigate high altitude plumes signature and contamination. Continue to investigate MHD flow control to optimize scramjet flow path performance. Continue to investigate lightweight superconducting magnet capability for MHD flow control of advanced engines.			
(U)			
(U) MAJOR THRUST: Explore combustion, propulsion, and diagnostics in subsonics, supersonics, and hypersonics.	7.722	8.443	9.226

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2308 Propulsion

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Investigate multi-phase, turbulent reacting flows to improve the performance of propulsion systems, including gas turbines, ramjets, scramjets, pulsed detonation engines, and rockets.			
(U)	In FY 2005: Improved laser diagnostic measurement capabilities in the characterization of reacting flows. Probed molecular transport effects causing and enhancing thermal destabilization of hydrocarbon fuels under supercritical thermodynamic conditions. Incorporated prediction methodologies, which are both quantitatively accurate and computationally tractable, into turbulent combustion models. Enhanced scientific bases for how plasmas are used to improve aerodynamic characteristics and propulsive efficiencies. Identified and evaluated fuels and propellants that are more energetic, environmentally benign, and less sensitive to accidental detonations.			
(U)	In FY 2006: Continue improving laser diagnostic measurement capabilities in the characterization of turbulent reacting flows. Probe deeper into molecular transport effects causing and enhancing thermal destabilization of hydrocarbon fuels under supercritical thermodynamic conditions. Further incorporate prediction methodologies, which are both quantitatively accurate and computationally tractable, into turbulent combustion models. Enhance scientific bases for how plasmas are used to improve aerodynamic characteristics and propulsive efficiencies. Continue to investigate fuels and propellants that are more energetic, environmentally benign, and less sensitive to accidental detonations.			
(U)	In FY 2007: Continue improving laser diagnostic measurement capabilities in the characterization of turbulent reacting flows. Continue to investigate molecular transport effects causing and enhancing thermal destabilization of hydrocarbon fuels under supercritical thermodynamic conditions. Further incorporate prediction methodologies, which are both quantitatively accurate and computationally tractable, into turbulent combustion models. Further enhance scientific bases for how plasmas are used to improve aerodynamic characteristics and propulsive efficiencies. Continue to investigate fuels and propellants that are more energetic, environmentally benign, and less sensitive to accidental detonations. Formulate strategies for using alternate hydrocarbon fuels based on the incorporation of detailed chemistry models into large eddy simulations.			
(U)				
(U)	CONGRESSIONAL ADD: Coal-Based Fuel	0.979	4.928	0.000
(U)	In FY 2005: Researched the production of coal-based jet fuels in increasingly larger quantities through refinery trials. Evaluated refinery-produced fuels for large-scale combustion and thermal stability for use in advanced high-performance engines.			
(U)	In FY 2006: Continue the efforts between the Energy Institute of Penn State and the United States Air Force (USAF) to enhance thermal stability for use in advanced high-performance engines. (Note: In FY 2005, this Add was called Coal-Derived Jet Fuels)			
(U)	In FY 2007: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2308 Propulsion**

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
(U) Total Cost	16.524	21.729	18.347

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602102F, Materials.									
(U) PE 0602203F, Aerospace Propulsion.									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0602601F, Space Technology.									
(U) PE 0603211F, Aerospace Structures.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 01 Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT NUMBER AND TITLE: 2311 Space and Information Sciences

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2311 Space and Information Sciences	29.553	30.488	27.005	25.489	25.368	25.829	26.255	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

Space and information sciences basic research provides fundamental understanding of the space environment for optimum design of Air Force systems operating in near-Earth orbit, geosynchronous orbit, and deep space. The goal is to enable greater, more cost-affordable, protection of space assets from space debris, solar wind, solar flares, cosmic rays, and geomagnetic storms. Focus is on specifying the flow of mass, momentum, and energy through space to develop a global model that connects solar activity with the deposition of energy at the Earth. Methods are developed to forecast the turbulent plasma phenomena that mediate the flow of energy through space in order to enhance the effectiveness of Air Force global dominance through space operations. The primary areas of research investigated by the space environment portion of this program are solar phenomena and weather, magnetospheric and ionospheric effects, space debris studies, and innovative space-based communications. The primary research areas in the information sciences portion of this program are complex systems and algorithms, communications and signal processing, information operations, and information fusion.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Research space environment to improve solar plasma theories and modeling in the areas of solar phenomena, space weather, magneto/ionosphere effects, space debris, adaptive optics for improved space observation, better space-based communications, and the quantifying of risks to space systems.	8.363	8.553	9.234

(U) In FY 2005: Exploited astronomical detection, tracking, and cataloging algorithms for enhanced protection of DoD surveillance capability in conjunction with data from the Communications/Navigation Outage Forecasting System-Solar Mass Ejection Imager (C/NOFS-SMEI) satellites. Supported development of ground-based advanced technology solar telescope adaptive optics systems, light detection and ranging radars, nanotechnology, and advanced signal-processing algorithms. Refined forecasting of ionosphere and space environment effects. Exploited developments in all-sky imaging and multi-conjugate adaptive optics to obtain infrared observations of ionospheric plasma physics, gravity waves, dynamics, optical clutter, and small, dim, deep space targets. Continued investigating solar flares, coronal mass ejections, magnetic reconnection in space plasmas, and solar magnetic field complexity.

(U) In FY 2006: Explore advanced modeling algorithms to take advantage of increased computer power and speed. Seek improved plasma models to enhance understanding of basic plasma theory. Seek fundamental processes of energetic particle scattering in the near-Earth environment to lay groundwork for protection of space assets. Continue investigating solar processes and energetic events, the solar wind, and fundamental processes in the magnetosphere, ionosphere, and thermosphere. Seek understanding of fundamental processes controlling space plasma to improve ability to forecast near-Earth space environment. Continue to exploit data from DoD surveillance assets in conjunction with data from C/NOFS-SMEI satellites to improve remote sensing of interplanetary space. Continue developing ground-based optical telescope technologies to include adaptive optics, photon detection,

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2311 Space and Information Sciences

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	spectral resolution, nanotechnology, advanced signal-processing algorithms, and developing space-based sensor technology. Continue to exploit developments in all-sky imaging and multi-conjugate adaptive optics to obtain visible and infrared observations of ionospheric plasma phenomena, optical clutter, and small, dim, deep space targets.			
(U)	In FY 2007: Expand development of ground-based optical telescope technologies (i.e., adaptive optics, photon detection, spectral resolution, nanotechnology, and advanced signal-processing algorithms) to include radio telescopes. Continue developing space-based sensor technology. Explore the solar interior as a complex system through advanced modeling techniques. Continue to explore advanced modeling algorithms to take advantage of increased computer power and speed, and to seek improved plasma models to enhance understanding of basic plasma theory. Develop understanding of fundamental processes of energetic particle scattering in the near Earth environment to support protection of space assets. Continue investigating solar processes and energetic events, the solar wind, and fundamental processes in the magnetosphere, ionosphere, and thermosphere. Seek understanding of fundamental processes controlling space plasma to improve ability to forecast near-Earth space environment. Continue to analyze data from DoD surveillance and the C/NOFS-SMEI satellites to improve remote sensing of interplanetary space. Initiate research to investigate the neutral winds above 150 kilometers. Employ all-sky imaging to study of ionospheric plasma phenomena and develop techniques to quantify these observations.			
(U)				
(U)	MAJOR THRUST: Investigate innovative technologies for space-based communication capabilities to ensure continued Air Force space dominance.	1.000	1.000	1.000
(U)	In FY 2005: Examined innovative methods for optical communications. Probed novel techniques for potential bandwidth efficient modulation to enhance satellite communications. Continued to explore the basic mechanisms of dual polarization antennas for space applications.			
(U)	In FY 2006: Widen consideration of innovative methods for optical communications. Continue to probe novel techniques for potential bandwidth efficient modulation to enhance satellite communications. Continue to explore the basic mechanisms of dual polarization antennas for space applications.			
(U)	In FY 2007: Investigate innovative methods for optical communications such as partial coherence, polarization modulation, and liquid crystal spatial modification techniques. Continue to explore the basic mechanisms of dual polarization antennas for space applications.			
(U)				
(U)	MAJOR THRUST: Investigate signal communications, surveillance, and targeting for increased awareness and improved command and control for the battlefield commander. Efforts include research in linear operator theory, generalized functions and probability, harmonic methods, and asymptotic expansions.	4.211	4.306	4.846

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2311 Space and Information Sciences**

(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2005	FY 2006	FY 2007
(U) In FY 2005: Improved data fusion science to permit rapid data conversion across multiple bands into graphical and conceptualized information. Promoted methodologies to evaluate the performance of new wireless mobile, networked communications systems. Assessed technical alternatives on the overall feasibility of super-resolution millimeter and search and rescue imagery. Solidified the hybrid radio-frequency (RF)/free-space optical paradigm and refined the parameters of other innovative technologies to attain ultra-fast, reliable information exchange. Enabled ultra-wide band transmission of hyperspectral and other diverse data.			
(U) In FY 2006: Further develop data fusion science to enable rapid data conversion across multiple bands into graphical and conceptualized information. Continue to promote methodologies to evaluate the performance of new wireless mobile, networked communications systems. Further assess technical alternatives on the overall feasibility of super-resolution millimeter and search and rescue imagery. Continue to solidify the hybrid RF/free-space optical paradigm and refine the parameters of other innovative technologies to attain ultra-fast, reliable information exchange. Further develop ultra-wide band transmission technology for hyperspectral and other diverse data.			
(U) In FY 2007: Continue exploring data fusion science to enable rapid data conversion across multiple bands into graphical and conceptualized information. Continue to study methodologies for evaluating the performance of new wireless mobile, networked communications systems. Continue study and assessment of technical alternatives for feasibility of super-resolution millimeter and search and rescue imagery. Continue to investigate the hybrid radio-frequency/free-space optical paradigm and refine the parameters of other innovative technologies to attain ultra-fast, reliable information exchange. Continue to develop ultra-wide band transmission technology for hyperspectral and other diverse data.			
(U)			
(U) MAJOR THRUST: Conduct research in complex systems and algorithms for highly flexible, reliable, secure, and rich information systems supporting battlefield commanders using artificial intelligence, information warfare techniques, intelligent agents, knowledge bases, distributed systems, machine learning, uncertainty reasoning, information warfare, and information fusion.	10.590	11.109	11.925
(U) In FY 2005: Continued research in information assurance for protection of future battlespace/infosphere systems and networks. Developed information fusion to provide deep, adaptive, expert decision support. Constructed quantum computer devices and algorithms to allow enhanced tracking, recognition, and characterization to improve awareness and command and control. Designed, implemented, and evaluated quantum-computing architectures for fast, accurate solutions of complex fluid dynamics.			
(U) In FY 2006: Develop information operations science techniques to proactively protect information intensive systems and networks. Further develop information fusion science to provide deep, adaptive, expert decision support. Exploit quantum and bio-computing techniques and algorithms to allow enhanced tracking, recognition, and characterization			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2311 Space and Information Sciences

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	to improve situational awareness, command and control, and security. Begin to investigate first principles of software system architectures.			
(U)	In FY 2007: Continue to develop information operations science techniques to exploit information intensive systems and networks. Further develop information fusion science to provide deep, adaptive, expert decision support. Continue to exploit quantum and bio-computing techniques and algorithms to allow enhanced tracking, recognition, and characterization to improve situational awareness, command and control, and security. Continue to investigate first principles of software system architectures including characteristic property metrics and begin development of automatic software architecture analysis tools.			
(U)				
(U)	CONGRESSIONAL ADD: Chabot Space and Science Center	1.960	0.000	0.000
(U)	In FY 2005: Increased the fundamental understanding of the upper atmosphere, as well as education outreach projects to support space science education programs designed to train the next generation of scientists and engineers.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Griffith Observatory's Planetarium	0.979	0.986	0.000
(U)	In FY 2005: Supported educational programming and exhibits that demonstrate the application of defense technology and research.			
(U)	In FY 2006: Continue to support educational programming and exhibits that demonstrate the application of defense technology and research. (Note: In FY 2005, this Add was called Demonstrating Space Research and Applications).			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Network Information and Space Security Center	2.450	4.534	0.000
(U)	In FY 2005: Conducted fundamental multi-disciplinary scientific research associated with network information and space security efforts.			
(U)	In FY 2006: Continue to conduct fundamental multi-disciplinary scientific research associated with network information and space security efforts to help satisfy critical U.S. Space Command needs.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	29.553	30.488	27.005

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2311 Space and Information Sciences**

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0602601F, Space Technology.									
(U) PE 0602702F, Command, Control, and Communications.									
(U) PE 0603410F, Space System Environmental Interactions Technology.									
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 01 Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE: 2312 Biological Sciences	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2312 Biological Sciences	9.437	9.687	10.052	10.501	10.774	10.974	11.159	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

Biological basic science research provides the fundamental knowledge necessary to understand and enable technologies associated with selected biological responses induced by chemical and physical agents, electromagnetic sensors based on biomimicry, biomolecular materials, biochromatics, and luminescence. The goal is to exploit biological properties to control and manipulate operational environments. Research topics are focused on the interactions of chemicals and physical agents (lasers and microwaves) with human tissues and associated effects to enable safety assessment strategies, hazard-free development and use of future air and space materials and directed energy systems, and innovation of biotechnologies to enhance the physiological performance and protection of Air Force personnel. Research in biomimetic sensors strives to mimic the biological detection systems of organisms at the molecular level in developing novel man-made sensors. Basic research in biocatalysis characterizes and bioengineers cellular enzymes to biosynthesize renewable hydrogen fuel from sunlight and water. Research in biomaterials focuses on the mimicking of natural materials, using organisms as biomaterial factories of new materials, genetically altering existing organisms for new materials capabilities, or taking existing biomaterials/organisms and using them as novel materials like viral gradients or processing them further to make a useful material as in biomineralization. Research in biointerfacial science is focused on new biosensors and bionanotechnology, and specifically addresses the fundamental science at either the biotic-biotic or the biotic-abiotic interface.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Characterize, understand, predict, control, and engineer biomolecular responses induced in organisms by chemical and physical agents of Air Force significance, such as alternate jet fuels, nano-energetic materials, and directed energy. Identify, characterize, and engineer novel enzymatic properties that enable photosynthetic microbes to use light energy for the renewable generation of hydrogen fuel from water. Explore biomolecular profiles and mechanisms involved in the stimulatory rather than inhibitory biological responses induced by low-doses of toxic agents.	5.459	5.493	5.746

(U) In FY 2005: Modeled risks associated with exposure to fuels and complex mixtures. Analyzed the biokinetics and biodistribution of JP-8 jet fuel components. Continued exploring, profiling, and modeling bio-informatics methodologies. Characterized, parameterized, and codified enzymes, proteins, biocatalysts, and bio-energetic agents to enable and enhance efficiencies in the synthesis and processing of future air and space materials.

(U) In FY 2006: Refine biokinetics models used to predict the fuel constituent levels in tissues following dermal and pulmonary exposures to fuel mixtures. Continue developing and begin applying methodologies for profiling and modeling the biomolecular responses induced by the interactions of directed energy and nano-energetic materials with biological systems. Begin developing and utilizing biocatalysis techniques for use in genetically engineering photosynthetic microbes to generate fuel-cell hydrogen from water. Begin exploring the dose ranges and kinetics associated with the positive stimulatory or "hormetic" responses of biological systems exposed to very low-levels of

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2312 Biological Sciences**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	known toxic substances and hazardous radiation.			
(U)	In FY 2007: Experimentally validate biokinetics models used to predict the fuel constituent levels in tissues following dermal and pulmonary exposures to fuel mixtures. Continue profiling and modeling the biomolecular responses induced by the interactions of directed energy and nano-energetic materials with biological systems. Continue utilizing biocatalysis techniques and genetic engineering principles to elicit the water-based generation of fuel-cell hydrogen by photosynthetic microbes. Investigate the biomolecular profiles for underlying mechanisms associated with positive stimulatory or "hormetic" responses of biological systems exposed to very low-levels of known toxic substances and hazardous radiation.			
(U)				
(U)	MAJOR THRUST: Explore biomimetics, biomaterials, and biointerfacial sciences to enable development of novel sensors, engineering processes, and mechanisms, and the synthesis of novel materials, as well as to research new sensor modalities, explore surface-mediated process, and delve into extreme environmental conditions.	3.978	4.194	4.306
(U)	In FY 2005: Investigated, evaluated, and modeled natural occurrences, processes, and designs for future applications in infrared devices. Explored biochromophores and biophotoluminescent characteristics in microbial and protein-based biosystems for applications to military sensor systems. Exploited biomaterial and biointerfacial sciences to synthesize novel materials, evaluate biosensors, and elucidate bionanotechnology applications.			
(U)	In FY 2006: Investigate, evaluate, model, and mimic biological processes and designs for future applications in near ambient temperature sensing devices. Probe and manipulate biochromophores and biophotoluminescent characteristics in microbial and protein-based biosystems for applications to military sensor systems. Continue to exploit biomaterial and biointerfacial sciences to synthesize novel materials, evaluate biosensors, and elucidate bionanotechnology applications.			
(U)	In FY 2007: Phase out investigating, evaluating, modeling, and mimicking biological processes and designs for future applications in near ambient temperature sensing devices, and add predator avoidance and new prey detection schemes as future technology areas. Further probe and manipulate biochromophores and biophotoluminescent characteristics in microbial and protein-based biosystems for applications to military sensor systems. Continue to exploit biomaterial and biointerfacial sciences to control cellular systems to synthesize novel materials, evaluate biosensors, and elucidate bionanotechnology applications. Research surface mediated cellular differentiation as a new sensor modality. Expand into extremophile research to access biosynthetic pathways not achievable with room temperature organisms.			
(U)	Total Cost	9.437	9.687	10.052

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2312 Biological Sciences**

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602202F, Human Effectiveness Applied Research.									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0602602F, Conventional Munitions.									
(U) PE 0602702F, Command, Control, and Communication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 01 Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT NUMBER AND TITLE: 2313 Human Performance

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2313 Human Performance	13.183	13.687	10.804	10.650	14.725	15.014	15.281	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

Human performance basic research provides the fundamental knowledge necessary to examine and exploit all aspects of human information processing critical to Air Force operations. The goal is to develop useful quantitative models of the way Air Force warfighters perceive, appraise, and manipulate their environment; make decisions in complex tasks under stress or uncertainty; and adapt to extreme sensory, biophysical, or cognitive workloads. Sensory research emphasizes visual, auditory, equilibrium, and kinesthetic systems and their optimal integration. Basic research topics focus investigations on developing Air Force technologies including specialized interactive displays, simulators, intelligent control systems, sensors and fused-image displays, and adaptive systems for operator and team training. Novel strategies to maintain decisive awareness by preventing impaired operating performance due to jet lag, shift work, night operations, and the loss of life and/or aircraft due to stress, inattention, or lack of vigilance are being evaluated. The primary areas of research investigated by this project are sensory systems; cognition, perception, and chronobiology; and behavioral and physiological measures of fatigue.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Probe human sensory systems and perceptions critical for warfighter performance (auditory and visual processes, multi-sensory integration, and sensory biomimetics) to enhance human-machine interaction in Air Force weapon systems. Research biophysical and neural mechanisms to determine human cognitive performance under conditions of sleep loss, sustained operations, and non-standard sleep/wake duty cycles.	4.763	5.079	5.445

(U) In FY 2005: Conducted empirical research with mathematical and/or computational modeling in spatial audition, speech perception, and hearing protection. Assessed multi-sensory integration methods and novel biological sensing mechanisms. Probed biophysical mechanisms responsible for fatigue. Evaluated models of sleep/wake dynamics to predict specific deficits in warfighter performance.

(U) In FY 2006: Continue to conduct empirical research with mathematical and computational modeling in spatial audition, speech perception, and hearing protection. Further assess multi-sensory integration methods and novel biological sensing mechanisms. Continue to probe biophysical mechanisms responsible for fatigue. Evaluate models of sleep/wake dynamics to predict specific consequences in the performance of an individual warfighter. Study the effects of ultrashort laser pulse on the eye (laser flash blindness).

(U) In FY 2007: Continue empirical research with mathematical and computational modeling in spatial audition, speech perception, and hearing protection. Exploit multi-sensory integration methods and novel biological sensing mechanisms. Continue to probe biophysical mechanisms responsible for fatigue. Further evaluate models of sleep/wake dynamics to predict specific consequences in the performance of an individual warfighter. Continue to investigate the effects of ultrashort laser pulse on the eye (laser flash blindness).

(U)

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2313 Human Performance

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST: Evaluate cognition and perception research to measure and analyze dimensions of human performance in complex, multi-interaction command and control tasks. Investigate behavioral and physiological theories of cognitive workload, alertness, and vulnerability to sleep loss.	5.620	5.158	5.359
(U)	In FY 2005: Analyzed models of enhanced human performance aided or augmented by intelligent systems. Assessed mechanisms affecting training effectiveness for operator and team performance. Continued modeling relationships between individual skill differences and interactions with envisioned training. Explored measures to avert/mitigate human error in conditions of information overload and fatigue.			
(U)	In FY 2006: Develop quantitative models and methods for improved understanding of individual and team information processing and decision making. Assess mechanisms affecting training effectiveness for individuals and teams. Continue modeling relationships between individual skill differences and interactions with envisioned training. Continue to explore measures to avert/mitigate human error and optimize decision making under conditions of uncertainty and information overload.			
(U)	In FY 2007: Refine quantitative models of individual and team information processing and decision-making including applications to systems to improve the speed and accuracy of networked teams. Employ progress on modeling individual and team training for the development of training systems optimized for specific individuals, teams, and applications. Assess mechanisms for continuous learning and automated, diagnostic mentoring of individuals. Develop models of symbolic spatial-imaginal processing. Continue exploring measures to avert/mitigate human error and optimize decision making under conditions of uncertainty and information overload.			
(U)				
(U)	CONGRESSIONAL ADD: Virtual Operation for Unmanned Aerial Vehicles	2.800	3.450	0.000
(U)	In FY 2005: Conducted research to design, develop, implement, and test the hardware, software, and aeronautical systems necessary to create immersive ground control stations based on virtual reality technology.			
(U)	In FY 2006: Support university research team that is designing, developing, implementing, and testing the hardware, software, and aeronautical systems necessary to create immersive ground control stations based on virtual reality technology.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	13.183	13.687	10.804

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602202F, Human									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2313 Human Performance**

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

Effectiveness Applied Research.

(U) PE 0602702F, Command, Control, and Communication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 01 Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE: 4113 External Research Programs Interface	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4113	External Research Programs Interface	12.281	7.687	8.696	9.045	18.446	18.815	19.157	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

The primary elements in this project are to facilitate interactions between the international and domestic research communities and Air Force researchers, and to support and develop scientists and engineers with an awareness of Air Force basic research priorities. These professional interactions and collaborations stimulate scientific and engineering education beneficial to the Air Force, increase the awareness of Air Force basic research priorities to the research community as a whole, and attract talented scientists and engineers to address Air Force needs. International interactions facilitate future interoperability of coalition systems and foster relationships with future coalition partners. This project also seeks to enhance educational interactions with historically black colleges and universities, Hispanic serving institutions, and other minority institutions.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Foster international science and technology cooperation by supporting the Air Force's international strategy mission. Identify and obtain unique foreign research capabilities through the international technology liaison missions of the European Office of Aerospace Research and Development and the Asian Office of Aerospace Research and Development.	3.903	4.004	4.520

(U) In FY 2005: Provided centralized cooperation expertise, supported international technology liaison missions, and identified unique research capabilities of high interest to the U.S. Air Force. Supported international visits of high-level DoD delegations and provided primary interface to coordinate international participation among DoD organizations. Aided in Air Force fiscal commitments to foreign NATO-affiliated research institutes.

(U) In FY 2006: Provide centralized cooperation expertise and support international technology liaison missions in order to identify and maintain awareness of foreign science and technology developments. Capitalize on foreign investments by influencing and acquiring world-class scientific research. Establish and maintain access to technical briefs and publications on unique foreign research and research capabilities. Support international visits of high-level DoD delegations and provide primary interface to coordinate international participation among DoD organizations. Aid in Air Force fiscal commitments to foreign NATO-affiliated research institutes.

(U) In FY 2007: Continue to provide centralized cooperation expertise and support international technology liaison missions in order to identify and maintain awareness of foreign science and technology developments. Continue to capitalize on foreign investments by influencing and acquiring world-class scientific research. Continue to seek and maintain access to technical briefs and publications on unique foreign research and research capabilities. Continue to support international visits of high-level DoD delegations and provide primary interface to coordinate international participation among DoD organizations. Continue to assist in Air Force fiscal commitments to foreign

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 4113 External Research Programs Interface

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	NATO-affiliated research institutes.			
(U)				
(U)	MAJOR THRUST: Strengthen science, mathematics, and engineering research and educational infrastructure in the U.S., thereby strengthening Air Force technical capabilities. Assure the Air Force of continuing availability of superior technical talent and forge Air Force Research Laboratory relationships with premiere scientists.	3.577	3.683	4.176
(U)	In FY 2005: Continued to support scientist and engineering research programs at U.S. colleges and universities, including historically black colleges and universities, Hispanic serving institutions, and other minority institutions. Enhanced awareness of Air Force research needs throughout civilian scientific community, while simultaneously identifying/recruiting the best scientific talent to participate in critical Air Force research.			
(U)	In FY 2006: Continue to support scientist and engineering research programs at U.S. colleges and universities, including historically black colleges and universities, Hispanic serving institutions, and other minority institutions. Enhance awareness of Air Force research needs throughout civilian scientific community, while simultaneously identifying/recruiting the best scientific talent to participate in critical Air Force research.			
(U)	In FY 2007: Continue to support science, mathematics, and engineering research and educational outreach programs at U.S. colleges and universities, including historically black colleges and universities, Hispanic serving institutions, and other minority institutions. Increase awareness of Air Force research needs throughout civilian scientific community, while simultaneously identifying/recruiting the best scientific talent to participate in critical Air Force research.			
(U)				
(U)	CONGRESSIONAL ADD: Minority LEADERS	4.801	0.000	0.000
(U)	In FY 2005: Conducted research in the areas of both materials and aerospace sensors.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	12.281	7.687	8.696

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0601103D, University Research Initiative.									
(U) PE 0602102F, Materials.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **4113 External Research Programs Interface**

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

(U) PE 0602201F, Aerospace Flight Dynamics.

(U) PE 0602202F, Human Effectiveness Applied Research.

(U) PE 0602203F, Aerospace Propulsion.

(U) PE 0602204F, Aerospace Avionics.

(U) PE 0602269F, Hypersonic Technology Program.

(U) PE 0602500F, Multi-Disciplinary Space Technology.

(U) PE 0602601F, Space Technology.

(U) PE 0602602F, Conventional Munitions.

(U) PE 0602702F, Command, Control and Communication.

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0601103F
PE TITLE: University Research Initiatives

Exhibit R-2, RDT&E Budget Item Justification

DATE: **February 2006**

BUDGET ACTIVITY: **01 Basic Research**

PE NUMBER AND TITLE: **0601103F University Research Initiatives**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	115.506	108.757	107.571	107.931	117.225	119.912	121.975	Continuing	TBD
5094 University Research Initiatives	115.506	108.757	107.571	107.931	117.225	119.912	121.975	Continuing	TBD

(U) A. Mission Description and Budget Item Justification

This program supports defense-related basic research in a wide range of scientific and engineering disciplines pertinent to maintaining U.S. military technology superiority; enhances and promotes the education of U.S. scientists and engineers in disciplines critical to maintaining, advancing, and enabling future U.S. defense technologies; and assists universities in establishing superior instrumentation capabilities needed to improve the quality of defense-related research and education. A fundamental component of this program is the recognition that future technologies and technology exploitations require highly coordinated and concerted multi- and interdisciplinary efforts. Note: In FY 2006, Congress added $1.1 million for 21st Century Information Operations Workforce; $1.5 million for Bio/Nano Electronic Devices and Sensors; $1.0 million for Military Logistics Readiness; $1.7 million for Secure and Assured Information Sharing. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation. Through this program, the Air Force invests in research directed toward increasing knowledge and understanding in those fields of science and engineering related to long-term national security needs.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	118.985	105.029	106.353
(U)	Current PBR/President's Budget	115.506	108.757	107.571
(U)	Total Adjustments	-3.479	3.728	
(U)	Congressional Program Reductions	0.000		
	Congressional Rescissions	-0.093	-1.572	
	Congressional Increases	0.000	5.300	
	Reprogrammings	0.025		
	SBIR/STTR Transfer	-3.411		
(U)	Significant Program Changes:			

Not Applicable.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 01 Basic Research	PE NUMBER AND TITLE: 0601103F University Research Initiatives	PROJECT NUMBER AND TITLE: 5094 University Research Initiatives	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5094	University Research Initiatives	115.506	108.757	107.571	107.931	117.225	119.912	121.975	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This program supports defense-related basic research in a wide range of scientific and engineering disciplines pertinent to maintaining U.S. military technology superiority; enhances and promotes the education of U.S. scientists and engineers in disciplines critical to maintaining, advancing, and enabling future U.S. defense technologies; and assists universities in establishing superior instrumentation capabilities needed to improve the quality of defense-related research and education. A fundamental component of this program is the recognition that future technologies and technology exploitations require highly coordinated and concerted multi- and interdisciplinary efforts. Note: In FY 2006, Congress added $1.1 million for 21st Century Information Operations Workforce; $1.5 million for Bio/Nano Electronic Devices and Sensors; $1.0 million for Military Logistics Readiness; $1.7 million for Secure and Assured Information Sharing. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation. Through this program, the Air Force invests in research directed toward increasing knowledge and understanding in those fields of science and engineering related to long-term national security needs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Promote fundamental, multi- and interdisciplinary science and engineering research projects. Topics will be selected in scientific research areas related to transformational and high priority technologies, such as nanotechnology, sensor networks, intelligence information fusion, smart materials and structures, efficient energy and power conversion, high energy materials for propulsion and control, and enhancing human performance.	57.512	52.388	54.269
(U) In FY 2005: Funded competitive research awards at U.S. universities to focus on underpinning Air Force-related technologies usually not achievable through typical single investigator awards. Continue funding of multi-disciplinary programs begun in prior years.			
(U) In FY 2006: Continue to fund competitive research awards at U.S. universities to focus on underpinning Air Force-related technologies usually not achievable through typical single investigator awards. Support and recognize superior academic research through the Presidential Early Career Award for Scientists and Engineers (PECASE). Continue funding of multi-disciplinary programs begun in prior years.			
(U) In FY 2007: Continue funding competitive research awards at U.S. universities to focus on underpinning Air Force-related technologies usually not achievable through typical single investigator awards. Continue to support and recognize superior academic researchers in the early stages of their career through PECASE. Continue funding of multi-disciplinary programs begun in prior years.			
(U)			
(U) MAJOR THRUST: Support post-graduate, graduate, and undergraduate education in science and engineering disciplines at U.S. universities. National Defense Science and Engineering Graduate Program (NDSEG) Fellowships	33.315	36.091	37.650

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601103F University Research Initiatives**	PROJECT NUMBER AND TITLE **5094 University Research Initiatives**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	are awarded to train U.S citizens in science and engineering disciplines of military importance under a joint tri-Service and Office of the Director of Defense Research and Engineering competition.			
(U)	In FY 2005: Awarded highly competitive NDSEG fellowships. Supported competitive awards for graduate and undergraduate research experiences including those established under the Awards to Stimulate and Support Undergraduate Research Education program. Stimulated and recognized superior academic research under Federal programs such as the PECASE. Continued funding for awards made under prior year Department of Defense programs.			
(U)	In FY 2006: Continue to award highly competitive NDSEG fellowships. Continue to support competitive awards for graduate and undergraduate research experiences including those established under the Awards to Stimulate and Support Undergraduate Research Education program. Continue funding for awards made under prior year Department of Defense programs.			
(U)	In FY 2007: Continue to award highly competitive NDSEG fellowships. Continue to support competitive awards for graduate and undergraduate research experiences including those established under the Awards to Stimulate and Support Undergraduate Research Education program. Continue funding for awards made under prior year Department of Defense programs.			
(U)				
(U)	MAJOR THRUST: Enhance the scientific and engineering research and education infrastructure and instrumentation at U.S. universities.	15.822	15.053	15.652
(U)	In FY 2005: Conducted the competition for U.S. universities to acquire state-of-the-art, high technology instrumentation and infrastructure to enhance research and educational capabilities under the Defense University Research Instrumentation Program.			
(U)	In FY 2006: Continue to conduct the competition for U.S. universities to acquire state-of-the-art, high technology instrumentation and infrastructure to enhance research and educational capabilities under the Defense University Research Instrumentation Program.			
(U)	In FY 2007: Continue to conduct the competition for U.S. universities to acquire state-of-the-art, high technology instrumentation and infrastructure to enhance research and educational capabilities under the Defense University Research Instrumentation Program.			
(U)				
(U)	CONGRESSIONAL ADD: 21st Century Information Operations Workforce	1.059	1.084	0.000
(U)	In FY 2005: Supported developments for an Information Operations curriculum to educate graduates and undergraduates in the field of intelligence.			
(U)	In FY 2006: Support an Information Operations curriculum to educate graduates and undergraduates in the field of			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601103F University Research Initiatives**	PROJECT NUMBER AND TITLE **5094 University Research Initiatives**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	intelligence.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Agile Response Chameleon Coating	1.443	0.000	0.000
(U)	In FY 2005: Conducted meta-materials research into aircraft coating systems that allow for stealth capabilities and advanced sensing capabilities.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Bio/Nano Electronic Devices and Sensors	2.889	1.479	0.000
(U)	In FY 2005: Conducted functionalized carbon nanotubes research and determine the feasibility of transferring information on the surface of photosensitive proteins at the single-molecule level.			
(U)	In FY 2006: Develop and demonstrate a prototype 3-D magnetic memory device with high storage capabilities and a high data transfer rate on an erasable medium and also to determine the feasibility of transferring information on the surface of photosensitive proteins at the single-molecule level. (Note: In FY 2005, this add was called Bio/Nanotechnology Infrastructure and Technology Oriented Research).			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Griffith Observatory Programming	0.962	0.000	0.000
(U)	In FY 2005: Supported educational programming and exhibits which demonstrate the application of defense technology and research at Griffith Observatory Planetarium.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Secure and Assured Information Sharing	1.542	1.676	0.000
(U)	In FY 2005: Conducted research in the security issues in information technology architectures and components.			
(U)	In FY 2006: Conduct research in the security issues in information technology architectures and components. (Note: In FY 2005, this add was called Information Security Solution).			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Military Logistics Readiness	0.962	0.986	0.000
(U)	In FY 2005: Continued support of the Air Force crew systems personnel protection program.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601103F University Research Initiatives**	PROJECT NUMBER AND TITLE **5094 University Research Initiatives**

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
(U) In FY 2006: Continue the support of the Air Force crew systems personnel protection program. (Note: In FY 2005, this add was called The Logistics Institute).			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	115.506	108.757	107.571

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:
PE 0601102F, Defense Research Sciences.

(U) D. Acquisition Strategy
Not Applicable.

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PE NUMBER: 0601108F
PE TITLE: High Energy Laser Research Initiatives

Exhibit R-2, RDT&E Budget Item Justification	DATE: February 2006
BUDGET ACTIVITY: 01 Basic Research	PE NUMBER AND TITLE: 0601108F High Energy Laser Research Initiatives

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	11.878	12.414	12.403	12.524	13.583	13.895	14.133	Continuing	TBD
5097 High Energy Laser Research Initiatves	11.878	12.414	12.403	12.524	13.583	13.895	14.133	Continuing	TBD

(U) A. Mission Description and Budget Item Justification

This program funds basic research aimed at developing fundamental scientific knowledge to support future Department of Defense (DoD) High Energy Laser (HEL) systems. HEL systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall DoD effort in HEL science and technology conducted by the HEL Joint Technology Office. In general, efforts funded under this program are chosen for their potential to have a broad impact on multiple HEL systems and Service missions, while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics, propagation, and free electron lasers. The program funds theoretical, computational, and experimental investigations. Note: In FY 2006, Congress added $0.7 million for Landscape Operational and Knowledge-based Characterization. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation. Through this program, the DoD invests in research directed toward increasing knowledge and understanding in those fields of science and engineering related to long-term national security needs.

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

	FY 2005	FY 2006	FY 2007
(U) Previous President's Budget	12.223	11.894	12.263
(U) Current PBR/President's Budget	11.878	12.414	12.403
(U) Total Adjustments	-0.345	0.520	
(U) Congressional Program Reductions			
Congressional Rescissions	-0.009	-0.180	
Congressional Increases		0.700	
Reprogrammings	-0.336		
SBIR/STTR Transfer			

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics
Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 01 Basic Research	PE NUMBER AND TITLE: 0601108F High Energy Laser Research Initiatives	PROJECT NUMBER AND TITLE: 5097 High Energy Laser Research Initiatves	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5097	High Energy Laser Research Initiatves	11.878	12.414	12.403	12.524	13.583	13.895	14.133	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This program funds basic research aimed at developing fundamental scientific knowledge to support future Department of Defense (DoD) High Energy Laser (HEL) systems. HEL systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall DoD effort in HEL science and technology conducted by the HEL Joint Technology Office. In general, efforts funded under this program are chosen for their potential to have a broad impact on multiple HEL systems and Service missions, while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics, propagation, and free electron lasers. The program funds theoretical, computational, and experimental investigations. Note: In FY 2006, Congress added $0.7 million for Landscape Operational and Knowledge-based Characterization. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation. Through this program, the DoD invests in research directed toward increasing knowledge and understanding in those fields of science and engineering related to long-term national security needs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Conduct fundamental research in solid state lasers focused on breaching the cost, power, and efficiency barriers to achieving the promise of simplified logistics, platform integration, and man-machine interface.	4.469	2.704	2.793

(U) In FY 2005: Conducted research in areas of interest including laser materials with large fluorescence lifetime and cross-section, laser materials with the ability to operate at high temperatures, athermal laser gain media, modular and scalable architectures for laser power scaling, means of increasing efficiency in excess of 20 percent, materials that can operate in harsh environments, and corrections for thermally induced distortions in gain media. Pursuant to the nature of the university-led, multidisciplinary research initiative program, all of the efforts to address the above research areas begun during FY 2002 continued to receive funding. Conducted FY 2005 proposal call for multidisciplinary research program and funded first year of new programs.

(U) In FY 2006: Conduct research in areas of interest including laser materials with large fluorescence lifetime and cross-section, laser materials with the ability to operate at high temperatures, athermal laser gain media, modular and scalable architectures for laser power scaling, means of increasing efficiency in excess of 30 percent, materials that can operate in harsh environments, and corrections for thermally induced distortions in gain media. Research focuses on ceramic gain material fabrication methods, low absorption laser gain media, laser-diode pump sources, fiber lasers, and vertical external cavity laser brightness and power extraction through advancements in cooling and

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601108F High Energy Laser Research Initiatives**	PROJECT NUMBER AND TITLE **5097 High Energy Laser Research Initiatves**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	fabrication techniques. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas begun during FY 2002 will continue to receive funding along with FY 2005 awards.			
(U)	In FY 2007: Conduct research in areas of interest including laser materials with large fluorescence lifetime and cross-section, laser materials with the ability to operate at high temperatures, athermal laser gain media, modular and scalable architectures for laser power scaling, means of increasing efficiency in excess of 30 percent, materials that can operate in harsh environments, and corrections for thermally induced distortions in gain media. Perform fiber laser research projects which focus on single aperture scaling of a single fiber and in eye-safer frequencies for fiber lasers and self organization of multiple fiber lasers. Research focuses on ceramic gain material fabrication methods, low absorption laser gain media, laser-diode pump sources, fiber lasers, and vertical external cavity laser brightness and power extraction through advancements in cooling and fabrication techniques. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas begun during FY 2002 will be completed. FY 2005 awards will continue to receive funding. Conduct proposal call for FY 2007 new starts.			
(U)				
(U)	MAJOR THRUST: Conduct fundamental research in high-power, lightweight optics.	0.330	1.561	1.739
(U)	In FY 2005: Conducted research in areas of interest including basic materials and fabrication techniques, large optics lightweight structure and deployment concepts, high energy laser (HEL) optical coatings, multipurpose materials. (e.g., wave front correction combined with aperture adjustment), and control mechanisms. Pursuant to the nature of the university-led, multidisciplinary research initiative program, all of the efforts to address the above research areas begun during FY 2002 continued to receive funding. Conducted FY 2005 proposal call for multidisciplinary research program and funded first year of new programs.			
(U)	In FY 2006: Conduct research in areas of interest including basic materials and fabrication techniques, large optics lightweight structure and deployment concepts, HEL optical coatings, multipurpose materials (e.g., wave front correction combined with aperture adjustment), and control mechanisms. Develop negative thermal expansion optical coating materials to match zero expansion substrates and measure thermal and strain responses of these coatings. Investigate heat transfer in micromachined adaptive mirrors. Develop methods to fabricate, measure, align, and coat large off axis aspherical optics. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas begun during FY 2002 will continue to receive funding along with FY 2005 awards.			
(U)	In FY 2007: Conduct research in areas of interest including basic materials and fabrication techniques, large optics lightweight structure and deployment concepts, HEL optical coatings, multipurpose materials (e.g., wave front correction combined with aperture adjustment), and control mechanisms. Develop negative thermal expansion optical coating materials to match zero expansion substrates and measure thermal and strain responses of these coatings. Investigate heat transfer in micromachined adaptive mirrors. Develop methods to fabricate, measure,			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601108F High Energy Laser Research Initiatives**	PROJECT NUMBER AND TITLE **5097 High Energy Laser Research Initiatves**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	align, and coat large off axis aspherical optics. Pursuant to the nature of the university-led multidisciplinary research initiative program, areas begun during FY 2002 will be completed. FY 2005 awards will continue to receive funding. Conduct proposal call for FY 2007 new starts.			
(U)				
(U)	MAJOR THRUST: Conduct research focused on the scientific concerns associated with atmospheric beam control including atmospheric characterization in aerial, battlefield, and maritime-like environments. These efforts could lead to substantial increases in the lethality of HEL systems without the need for significantly increased power levels.	1.488	1.106	1.155
(U)	In FY 2005: Conducted research in areas of interest including improved theoretical and computer-based analysis of propagation effects, advanced wave front sensing and reconstruction (especially in the presence of thermal blooming), and the effects of extended reference sources used for wave front correction. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas that were begun during FY 2002 continued to receive funding. Conducted and funded first year of FY 2005 proposal call for multidisciplinary research program.			
(U)	In FY 2006: Conduct research in areas of interest including improved theoretical and computer-based analysis of propagation effects, advanced wave front sensing and reconstruction (especially in the presence of thermal blooming), and the effects of extended reference sources used for wave front correction. Research focuses on new methods for wave front control, imaging and tracking through turbulence, and modeling and simulation of beam propagation. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas that were begun during FY 2002 continue to receive funding along with FY 2005 awards.			
(U)	In FY 2007: Conduct research in areas of interest including improved theoretical and computer-based analysis of propagation effects, advanced wave front sensing and reconstruction (especially in the presence of thermal blooming), and the effects of extended reference sources used for wave front correction. Research focuses on new methods for wave front control, imaging and tracking through turbulence, and modeling and simulation of beam propagation. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas that were begun during FY 2002 will be completed. FY 2005 awards will continue to receive funding. Conduct proposal call for FY 2007 new starts.			
(U)				
(U)	MAJOR THRUST: Conduct fundamental research in chemical lasers to improve the understanding of the processes necessary for the realization of truly closed cycle, lightweight, high-power, continuously operating chemical lasers.	1.870	1.191	1.361
(U)	In FY 2005: Conducted research in areas of interest including studies of chemical processes and reactions for a closed-cycle chemical laser system, new sources of the high-energy chemical species needed to produce the lasing event, and electrically driven oxygen iodine laser architectures. Measured chemical kinetics for an all gas phase chemical laser and study plasma physics of an electrically driven oxygen iodine laser system. Pursuant to the nature			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601108F High Energy Laser Research Initiatives**	PROJECT NUMBER AND TITLE **5097 High Energy Laser Research Initiatves**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	of the university-led, multidisciplinary research initiative program, areas that were begun during FY 2002 continued to receive funding. Conducted FY 2005 proposal call for multidisciplinary research program and funded first year of new programs.			
(U)	In FY 2006: Conduct research in areas of interest including studies of chemical processes and reactions for a closed-cycle chemical laser system, new sources of the high-energy chemical species needed to produce the lasing event, and electrically driven oxygen iodine laser system. Pursuant to the nature of the university-led, multidisciplinary research initiative program, all of the efforts to address the above research areas that were begun during FY 2002 will continue to receive funding along with FY 2005 awards.			
(U)	In FY 2007: Conduct research in areas of interest including studies of chemical processes and reactions for a closed-cycle chemical laser system, new sources of the high-energy chemical species needed to produce the lasing event, and electrically driven oxygen iodine laser system. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas that were begun during FY 2002 will be completed. FY 2005 awards will continue to receive funding. Conduct proposal call for FY 2007 new starts.			
(U)				
(U)	MAJOR THRUST: Conduct fundamental research in high-average-power, ultra-short-pulse free electron lasers to significantly increase the average power obtainable by ultra-short-pulse free electron lasers, while decreasing relative size and cost.	1.770	1.475	1.533
(U)	In FY 2005: Conducted research in areas of interest including high-current devices and control methods, higher damage threshold resonator optics, advanced optical cavity designs for high power and compact spaces, and design methods for scaling free electron lasers to reach multi-megawatt class average power levels. Pursuant to the nature of the university-led, multidisciplinary research initiative program, all of the efforts to address the above research areas begun during FY 2002 continued to receive funding. Conducted FY 2005 proposal call for multidisciplinary research program and funded first year of new programs.			
(U)	In FY 2006: Conducted research in areas of interest including studies of chemical processes and reactions for a closed-cycle chemical laser system, new sources of the high-energy chemical species needed to produce the lasing event, and electrically driven oxygen iodine laser architectures. Measured chemical kinetics for an all gas phase chemical laser and study plasma physics of an electrically driven oxygen iodine laser system. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas that were begun during FY 2002 continued to receive funding along with FY 2005 awards.			
(U)	In FY 2007: Conduct research in areas of interest including studies of chemical processes and reactions for a closed-cycle chemical laser system, new sources of the high-energy chemical species needed to produce the lasing event, and electrically driven oxygen iodine laser architectures. Measure chemical kinetics for an all gas phase			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601108F High Energy Laser Research Initiatives**	PROJECT NUMBER AND TITLE **5097 High Energy Laser Research Initiatves**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	chemical laser and study plasma physics of an electrically driven oxygen iodine laser system. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas that were begun during FY 2002 will be completed. FY 2005 awards will continue to receive funding. Conduct proposal call for FY 2007 new starts.			
(U)				
(U)	MAJOR THRUST: Conduct fundamental research in modeling and simulation for HELs.	1.655	1.475	1.533
(U)	In FY 2005: Developed models and simulation techniques to achieve a balance between high-fidelity technical analyses, engineering trade studies that allow analyses of a wide range of systems, and analyses of HEL systems' military utility in a broad range of missions. Pursuant to the nature of the university-led, multidisciplinary research initiative program, all of the efforts to address the above research areas begun during FY 2002 continued to receive funding. Conducted FY 2005 proposal call for multidisciplinary research program and funded first year of new programs.			
(U)	In FY 2006: Continue development of models and simulation techniques to achieve a balance between high-fidelity technical analyses, engineering trade studies that allow analyses of a wide range of systems, and analyses of HEL systems' military utility in a broad range of missions. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas that were begun during FY 2002 continue to receive funding along with FY 2005 awards.			
(U)	In FY 2007: Conduct research in areas of modeling and simulation to achieve a balance between high-fidelity technical analyses, engineering trade that allow analyses of a wide range of systems, and analyses of HEL system's military utility in a broad range of missions. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas that were begun during FY 2002 continue to receive funding along with FY 2005 awards. Conduct proposal call for FY 2007 new starts.			
(U)				
(U)	MAJOR THRUST: Conduct fundamental research in beam control component technology to improve HEL systems.	0.296	2.212	2.289
(U)	In FY 2005: Developed beam control technology to improve HEL system performance. Provided critical technology options for use in tactical scenarios on tactical platforms such as aircraft, ground vehicles, and technology to fabricate conformal HEL windows for tactical air vehicles. Developed wavefront sensors that are insensitive to high scintillation environments and prepare to benchmark performance in a simulated high scintillation environment. Established a government optical metrology capability to precisely measure adsorption and reflectivity of optical coatings. Developed methods for discrimination, pointing, and tracking in high clutter using three-dimensional imaging. Developed characterizations that concentrate on understanding atmospheric limitations in low-altitude tactical scenarios in order to increase the lethal range. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas that were begun during FY 2002 continued to receive funding. Conducted			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601108F High Energy Laser Research Initiatives**	PROJECT NUMBER AND TITLE **5097 High Energy Laser Research Initiatves**

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	FY 2005 proposal call for multidisciplinary research program and funded first year of new program.			
(U)	In FY 2006: Continue to develop beam control technology to improve HEL system performance. Provide critical technology options for use in tactical scenarios on tactical platforms such as aircraft and ground vehicles. Develop technology to fabricate conformal HEL windows for tactical air vehicles. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas that were begun during FY 2002 continue to receive funding along with FY 2005 awards.			
(U)	In FY 2007: Continue to develop beam control technology to improve HEL system performance. Provide critical technology options for use in tactical scenarios on tactical platforms such as aircraft and ground vehicles. Develop technology to fabricate conformal HEL windows for tactical air vehicles. Pursuant to the nature of the university-led, multidisciplinary research initiative program, areas that were begun during FY 2002 continue to receive funding along with FY 2005 awards. Conduct proposal call for FY 2007 new starts.			
(U)				
(U)	CONGRESSIONAL ADD: Landscape Operational and Knowledge-based Characterization.	0.000	0.690	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Landscape Operational and Knowledge-based Characterization.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	11.878	12.414	12.403

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0602890F, High Energy Laser Research.									
(U) PE 0603444F, Maui Space Surveillance System.									
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601108F High Energy Laser Research Initiatives**	PROJECT NUMBER AND TITLE **5097 High Energy Laser Research Initiatves**

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

(U) PE 0603605F, Advanced Weapons Technology.

(U) PE 0603924F, High Energy Laser Advanced Technology Program.

(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.

(U) PE 0602605F, Directed Energy Technology.

(U) PE 0602307A, Advanced Weapons Technology.

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

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

(U) D. Acquisition Strategy

Not Applicable.

PE NUMBER: 0602015F
PE TITLE: Medical Development

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602015F Medical Development

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	0.000	18.434	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5244 Diabetes Research	0.000	18.434	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: Funds for the FY 2006 Congressionally-directed National Diabetes Model Program in the amount of $17.0 million and Assessment and Demonstration Center for USAF Surgeon General in the amount of $1.7 million are in the process of being moved to the Defense Health Program, from PE 0602015F, Medical Development, for execution.

(U) A. Mission Description and Budget Item Justification

Funds for the FY 2006 Congressionally-directed National Diabetes Model Program in the amount of $17.0 million and Assessment and Demonstration Center for USAF Surgeon General in the amount of $1.7 million are in the process of being moved to the Defense Health Program, from PE 0602015F, Medical Development, for execution.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	0.000	0.000	0.000
(U)	Current PBR/President's Budget	0.000	18.434	0.000
(U)	Total Adjustments	0.000	18.434	
(U)	Congressional Program Reductions			
	Congressional Rescissions		-0.266	
	Congressional Increases		18.700	
	Reprogrammings			
	SBIR/STTR Transfer			

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics
Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602015F Medical Development

PROJECT NUMBER AND TITLE: 5244 Diabetes Research

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5244 Diabetes Research	0.000	18.434	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the FY 2006 Congressionally-directed National Diabetes Model Program in the amount of $17.0 million and Assessment and Demonstration Center for USAF Surgeon General in the amount of $1.7 million are in the process of being moved to the Defense Health Program, from PE 0602015F, Medical Development, for execution.

(U) A. Mission Description and Budget Item Justification

Funds for the FY 2006 Congressionally-directed National Diabetes Model Program in the amount of $17.0 million and Assessment and Demonstration Center for USAF Surgeon General in the amount of $1.7 million are in the process of being moved to the Defense Health Program, from PE 0602015F, Medical Development, for execution.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) CONGRESSIONAL ADD: National Diabetes Model Program.	0.000	16.758	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Conduct Congressionally-directed effort for National Diabetes Model Program.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) CONGRESSIONAL ADD: Assessment and Demonstration Center for the USAF Surgeon General.	0.000	1.676	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Conduct Congressionally-directed effort for Assessment and Demonstration Center for the USAF Surgeon General.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	0.000	18.434	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:
Not Applicable.

(U) D. Acquisition Strategy

Not Applicable.

PE NUMBER: 0602102F
PE TITLE: Materials

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602102F Materials

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	117.460	121.451	111.073	116.564	118.397	119.912	121.275	Continuing	TBD
01SP	Space Materials Development	0.000	0.000	26.611	35.959	38.260	39.077	39.868	Continuing	TBD
4347	Materials for Structures, Propulsion, and Subsystems	71.274	74.572	45.264	47.907	45.656	46.006	46.260	Continuing	TBD
4348	Materials for Electronics, Optics, and Survivability	21.763	19.260	18.119	12.630	13.324	13.466	13.612	Continuing	TBD
4349	Materials Technology for Sustainment	17.365	16.817	18.417	17.516	18.456	18.631	18.774	Continuing	TBD
4915	Deployed Air Base Technology	7.058	10.802	2.662	2.552	2.701	2.732	2.761	Continuing	TBD

Note: In FY 2007, Project 01SP, Space Materials Development, efforts will transfer from PE 0602500F, Multidisciplinary Space Technology, Project 5025, Space Materials Development, in order to more effectively manage and provide oversight of the efforts. Funds for the FY 2006 Congressionally-directed Carbon Nanostructured Material for Fluid Purification in the amount of $5.0 million are in the process of being moved to PE 0602202F, Human Effectiveness Applied Research, from PE 0602102F, Materials, for execution. Funds for the FY 2006 Congressionally-directed Fully-Integrated Solar-Powered Interior Lighting Technology in the amount of $1.0 million are in the process of being moved to PE 0602102F, Materials, from PE 0601102F, Defense Research Sciences, for execution.

(U) A. Mission Description and Budget Item Justification

This program develops advanced materials, processing, and inspection technologies to reduce life cycle costs and improve performance, affordability, supportability, reliability, and survivability of current and future Air Force systems and operations. The program has four projects that develop: (1) structural, propulsion, and sub-systems materials and processes technologies; (2) electronic, optical, and survivability materials and processes technologies; (3) sustainment materials, processes technologies, and advanced non-destructive inspection methodologies; and (4) air base operations technologies including deployable base infrastructure, force protection, and fire fighting capabilities. Note: In FY 2006, Congress added $1.0 million for Polymer Nanocomposites as Future Materials for Defense and Energy Applications, $1.4 million for Computational Tools for Materials Development, $2.0 million for Domestic Titanium Powder Manufacturing Initiative, $3.2 million for Power Electronics Reliability, $2.25 million for Domestic High Modulus Polyacrylonitrile (PAN) Carbon Fiber Qualification Initiative, $2.1 million for Large Area, Advanced Physical Vapor Transport (APVT) Materials for Hi-Powered Devices, $1.7 million for Safer Nanomaterials and Nanomanufacturing, $1.4 million for Blast Resistant Barriers for Homeland Defense, $1.0 million for Advanced Materials Deposition for Semiconductor, $1.0 million for Advanced Manufacturing Technologies for Metals, Composites, Materials, $3.5 million for Air Force Minority Leaders Program, $5.0 million for Carbon Nanostructured Material for Fluid Purification, $1.0 million for Complex Composite Structures for Manned-Unmanned Air Vehicles, $1.5 million for Innovative Process for Continuous Fabrication of Carbon Nanotube Membranes, $1.0 million for Durable Hybrid Coatings for Aircraft Systems, $1.1 million for Engineered Optical Materials for High Energy Laser Development, $1.0 million for Nanoparticle Materials Coatings Research, $11.0 million for Strategic Partnership for Research in Nanotechnology, $2.1 million for Thermal Sprays for Structural Protection, $1.8 million for Minority LEADERS Research Program, $1.0 million for Nano Organic Polymer Materials: Dynamic Camouflage, $1.0 million for Chrome-Free Environmentally Friendly Corrosion Protection for Aircraft, and $1.0 million for Nanomaterials Commercialization Center of Pennsylvania. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**

technologies.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	119.498	74.156	78.620
(U)	Current PBR/President's Budget	117.460	121.451	111.073
(U)	Total Adjustments	-2.038	47.295	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.092	-1.755	
	Congressional Increases		49.050	
	Reprogrammings			
	SBIR/STTR Transfer	-1.946		

(U) Significant Program Changes:

In FY 2007, Project 01SP, Space Materials Development, efforts will transfer from PE 0602500F, Multidisciplinary Space Technology, Project 5025, Space Materials Development, in order to more effectively manage and provide oversight of the efforts.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT NUMBER AND TITLE: 01SP Space Materials Development

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
01SP Space Materials Development	0.000	0.000	26.611	35.959	38.260	39.077	39.868	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, Project 01SP, Space Materials Development, efforts will transfer from PE 0602500F, Multidisciplinary Space Technology, Project 5025, Space Materials Development, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops the materials and processing technology base for spacecraft and launch systems to improve affordability, maintainability, and performance of current and future Air Force space systems. Families of affordable lightweight materials are being developed, including metals, polymers, ceramics, metallic composites, and nonmetallic composites to provide new capabilities for spacecraft, ballistic missile, and propulsion systems to meet the future space requirements. Rocket propulsion materials development in this project supports the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program. Advanced high-temperature protection materials are being developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet space and ballistic missile requirements. Materials technologies are also being developed to enable surveillance and terrestrial situational awareness systems and subsystems for space and ballistic missile applications.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop materials and processes to dramatically improve performance, durability, and cost of rocket propulsion systems.	0.000	0.000	11.500
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Develop new candidate materials and improved processing techniques to ensure more consistent material characteristics to meet the next level of performance goals for high-speed turbopump housings and turbines, ducts, valves, solid rocket casings, insulation, and nozzle throats. Evaluate performance of subscale test components in representative rocket engine environment. Continue analysis of material behavior in rocket combustion environment. Demonstrate innovative high-temperature metal, ceramic, and composite material candidates for solid rocket nozzles, exit cones, throats, and spacecraft propulsion components. Validate material models for direct replacement of materials. Scale-up testing from coupon level to more complex shapes and sizes. Fabricate subscale components. Incorporate innovative materials and concepts on demonstrator engines. Identify materials characteristics required to meet advanced performance and cost goals. Improve and optimize selected materials, test sub-elements, and sub-components for thrust chambers, nozzles, and catalysts.			
(U)			
(U) MAJOR THRUST: Develop affordable, advanced structural and non-structural materials and processing technologies for Air Force space applications.	0.000	0.000	11.008
(U) In FY 2005: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NUMBER AND TITLE 01SP Space Materials Development

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Validate initial material design concept of candidate metallic systems for thin gage structures for component operation in robust high-temperature, long duration cruise, or access to space environments. Continue analysis of research results and develop knowledge base on liquid oxygen compatibility with National Aeronautics and Space Administration (NASA) and industry. Evaluate large integrated concepts using composite materials in cryogenic environments and provide expertise for design and assessment of structural cryogenic tanks. Demonstrate high-temperature protection systems for expendable and reusable high-speed vehicle applications in collaboration with industry. Validate oxidation protection schemes for carbon-carbon materials for high-speed vehicle applications. Develop multifunctional nano-tailored composite technologies for space system capabilities and evaluate enhancements obtained. Continue to develop wear-resistant materials, lubricants, and Micro-Electro-Mechanical System (MEMS) devices for moving mechanical assemblies on spacecraft. Continue to evaluate candidate space materials and collect critical data to facilitate materials transition.			
(U)				
(U)	MAJOR THRUST: Develop materials and materials processing technologies to enable improved performance and affordability of surveillance, tracking, targeting, and situational awareness systems.	0.000	0.000	4.103
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Initiate development of nano-photonic materials for high performance optoelectronic devices for optical communications and system control architectures. Validate processes and develop process control methodology to enable very long wavelength infrared detection. Continue to develop suitable materials and materials process technologies for application in combined optical and radio frequency communication system apertures. Initiate research in nano-photonic materials for applications in very high bandwidth communications and modulators, laser communications, and radar.			
(U)	Total Cost	0.000	0.000	26.611

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Not applicable.									

(U) D. Acquisition Strategy

Not applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4347 Materials for Structures, Propulsion, and Subsystems**	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4347	Materials for Structures, Propulsion, and Subsystems	71.274	74.572	45.264	47.907	45.656	46.006	46.260	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the FY 2006 Congressionally-directed Fully-Integrated Solar-Powered Interior Lighting Technology in the amount of $1.0 million are in the process of being moved to PE 0602102F, Materials, from PE 0601102F, Defense Research Sciences, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops the materials and processing technology base for aircraft and missiles to improve affordability, maintainability, and performance of current and future Air Force systems. A family of affordable lightweight materials is being developed, including metals, polymers, ceramics, metallic composites, and nonmetallic composites to provide upgraded capabilities for existing aircraft, missile, and propulsion systems to meet the future system requirements. Develops high-temperature turbine engine materials that will enable engine designs to double the turbine engine thrust to weight ratio. Advanced high temperature protection materials are being developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet aerospace and missile requirements. Alternative or replacement materials are being developed to maintain the performance of aging operational systems. Friction and wear-resistant materials, paints, coatings, and other pervasive nonstructural materials technologies are being developed for propulsion and subsystems on aircraft, spacecraft, and missiles. Concurrently develops advanced processing methods to enable adaptive processing of aerospace materials.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop ceramics and ceramic matrix composite technologies for revolutionary performance and supportability improvements in advanced propulsion systems and high temperature aerospace structures.	5.738	4.077	3.833

(U) In FY 2005: Developed damage resistant advanced ceramic composites for high friction and fracture-prone environments. Tested tip rub tolerant concepts for ceramic blades. Updated the advanced ceramic composites life prediction model to permit prediction of its durability under stress gradients, temperature gradients, and long-term thermal exposure. Fabricated and tested integrally cooled ceramic composite sub-elements and small components. Developed laboratory-scale advanced fiber-matrix interface concepts, optimizing the robustness of these state-of-the-art ceramic composites in severe environments.

(U) In FY 2006: Design, fabricate, and test advanced ceramic composite coupons and sub-elements for demonstration of durability. Expand the ceramic composite life prediction model to account for complex component shapes and apply to complex turbine component shapes. Develop material/component acceptance criteria. Validate advanced weaving and design methodology of integrally cooled ceramic composites by designing, fabricating, and testing an annular trapped vortex combustor. Scale up advanced fiber-matrix interface coating concepts and apply to state-of-the-art ceramic composites.

(U) In FY 2007: Demonstrate advanced ceramic composite performance through testing under real and simulated engine

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4347 Materials for Structures, Propulsion, and Subsystems**

(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2005	FY 2006	FY 2007
service life conditions. Incorporate environmental degradation analysis into the ceramic composite life prediction model to address time dependent degradation associated with environmental exposure and validate the model. Demonstrate the severe environment durability of advanced ceramic composite systems with advanced interfaces via mechanical testing.			
(U)			
(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop enabling polymeric materials for diverse aerospace structural applications including enhanced aircraft canopies, micromechanical devices, advanced wiring concepts, and improved low-observable platforms. Note: This effort includes Congressional Add funding of $13.0 million in FY 2005 ($2.5 million for ONAMI Safer Nanomaterials and Nanomanufacturing and $10.5 million for Strategic Partnership for Research in Nanotechnology) and $16.2 million in FY 2006 ($1.0 million for Polymer Nanocomposites as Future Materials for Defense and Energy Applications, $1.7 million for Safer Nanomaterials and Nanomanufacturing, and $1.5 million for Innovative Process for Continuous Fabrication of Carbon Nanotube Membranes, $11.0 million for Strategic Partnership for Research in Nanotechnology, and $1.0 million for Nano Organic Polymer Materials: Dynamic Camouflage).	16.971	19.815	5.633
(U) In FY 2005: Established the enhanced performance of nanostructured polymeric materials for gas and fluid containment. Developed techniques and materials for nanoscale architectures to address advanced Air Force conducting, structural, and electromechanical applications. Completed development of a hybrid thin wire making process. Completed development of Two Photon Absorbing (TPA) polymer materials for night vision goggle and sensor protection applications. Tested the durability of waterborne conductive nanocomposites. Enhanced conductive polymeric nanocomposites for use in elimination of secondary conductive coatings for aircraft lightning strike protection. Demonstrated the feasibility of lightweight radio frequency polymer substrates for reduced aperture size, conformal radar, and antenna systems.			
(U) In FY 2006: Continue to develop techniques and materials for nanoscale architectures to address advanced Air Force conducting, structural, and electromechanical applications. Develop second-generation TPA materials for night vision goggle and optical limiting applications. Investigate use of photonic crystals to enhance second- and third-order nonlinear optical properties for use in optical limiting applications. Demonstrate improved life for Air Force aircraft tires by incorporation of nanostructured polymeric materials. Validate aromatic hyperbranched polymers as viscosity-lowering additives for structural component manufacture via solvent-free processes. Investigate microfabrication of organic-inorganic nanophotonic structures that have the potential to impact Air Force electromagnetic applications for reduced aperture size, conformal radar, and antenna systems. Begin development of adaptive (shape memory and actuator) materials based on polymer nanocomposites for adaptive aircraft structures, wings, fins, antennas, and mirrors. Scale up improved polymer proton exchange membranes for high efficiency, long			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4347 Materials for Structures, Propulsion, and Subsystems**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	life, lightweight, fuel cell applications. Demonstrate polymer photovoltaic materials for high efficiency, long life, lightweight, solar cell applications.			
(U)	In FY 2007: Continue to develop techniques and materials for nanoscale architectures to address advanced Air Force conducting, structural, and electromechanical applications. Continue to develop second-generation TPA materials for night vision goggle and optical limiting applications. Demonstrate optical limiting with improvements in nonlinear optical properties using photonic crystals. Demonstrate improved life nanostructured aircraft tires. Demonstrate aromatic hyperbranched polymers as rheology-modifying additives for structural component manufacture via resin transfer molding processes. Demonstrate organic-inorganic nanostructured materials for Air Force electromagnetic applications. Continue development of adaptive (shape memory and actuator) materials based on polymer nanocomposites for adaptive aircraft structures, wings, fins, antennas, and mirrors. Demonstrate polymer proton exchange membranes for Air Force fuel cell applications. Demonstrate polymer photovoltaic materials for high efficiency, long life, lightweight, solar cell applications.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop affordable lightweight metallic materials, behavior and life prediction technologies, higher temperature intermetallic alloys, and metals processing technology to enable enhanced performance, lower acquisition costs, increased durability, and improved reliability for Air Force weapon systems. Note: This effort includes Congressional Add funding of $10.0 million in FY 2005 ($3.5 million for Advanced Manufacturing Technologies for Metals, Composites (UMR), $2.0 million for Domestic Titanium Powder Manufacturing Initiative, $2.5 million for Titanium Matrix Composites, $1.0 million for Computational Tools for Materials Development, and $1.0 million for Optimal Design of Materials Processes) and $4.4 million in FY 2006 ($1.0 million for Advanced Manufacturing Technologies for Metals, Composites, Materials, $2.0 million for Domestic Titanium Powder Manufacturing Initiative, and $1.4 million for Computational Tools for Materials Development).	22.408	19.252	17.315
(U)	In FY 2005: Developed reliable life extension capabilities for turbine engine rotors. Evaluated performance of high-temperature structural materials through preliminary certification testing and/or ground-based engine rig testing. Initiated concept identification of advanced metallic materials for enhanced performance propulsion for air platforms with an emphasis on higher temperature capability. Developed and matured computational methods of modeling mechanical properties to metal suppliers and vendors to enable cost and schedule savings due to reduced amount of proof and release testing. Evaluated processes and protocols for unitized manufacturing of aerospace components.			
(U)	In FY 2006: Demonstrate reliable life extension capability for turbine engine rotors. Explore materials-damage predictive approaches for engine health determination and life extension capability. Explore advanced metallic materials for enhanced performance propulsion for air platforms with an emphasis on higher temperature capability.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4347 Materials for Structures, Propulsion, and Subsystems**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Explore computational methods supporting development and processing to reduce costs to accelerate insertion of advanced metals into Air Force systems. Continue the identification of processes and protocols for unitized manufacturing of aerospace components.			
(U)	In FY 2007: Develop materials-damage predictive approaches for engine health determination and life extension capability. Continue exploration of advanced metallic materials for enhanced performance propulsion for air platforms with an emphasis on higher temperature capability. Develop computational methods supporting development and processing to reduce costs to accelerate insertion of advanced metals into Air Force systems. Demonstrate processes and protocols for unitized manufacturing of aerospace components.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop affordable, advanced organic matrix composite structural materials and technologies for Air Force systems applications including lightweight structures for aerospace subcomponents and other structures requiring thermal and/or structural management for environmental control. Note: This effort includes Congressional Add funding of $8.5 million in FY 2005 ($1.0 million for Cost-Effective Composite Materials for Manned and Unmanned Flight Structures, $1.1 million for Materials Science Laboratory, $3.6 million for Nanostructured Materials for Advanced Air Systems, and $2.8 million for Wright Brothers Institute - Nanostructured Materials for Advanced Air Force Systems) and $3.25 million in FY 2006 ($1.0 million for Complex Composite Structures for Manned-Unmanned Air Vehicles and $2.25 million for Domestic High Modulus PAN Carbon Fiber Qualification Initiative).	16.721	13.096	9.790
(U)	In FY 2005: Developed life prediction capabilities for high temperature turbine engines and airframe hot structures. Optimized materials and processing scale-up of high temperature organic matrix composites for affordable turbine, aircraft structures, and high-speed vehicle applications. Developed materials and processes for nanomaterials as matrix additives and/or high performance composites with tailored and multi-functional capabilities. Tested materials and processes at the subcomponent level for improved reliability and performance for thermal management applications.			
(U)	In FY 2006: Continue development of life prediction capabilities for high temperature turbine engine and airframe hot structures. Demonstrate high temperature organic matrix composites onto relevant DoD platforms. Investigate and assess future requirements for material development as applied to next generation high-speed vehicle applications. Continue development of materials and processes for nanotailored composites with multifunctional capabilities. Initiate nanomaterial modeling efforts. Continue demonstration of novel materials and processes that enhance the reliability and performance of thermal management subsystems.			
(U)	In FY 2007: Demonstrate tools and methodologies required for life prediction of materials in high temperature turbine engine and airframe structures environments. Continue demonstration of high temperature organic matrix			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4347 Materials for Structures, Propulsion, and Subsystems**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	composites onto relevant DoD platforms. Initiate new material development and affordable processing for space and high-speed vehicle applications. Continue development of new materials and processes for nanotailored composites with multifunctional capabilities. Continue nanomaterial modeling and technology efforts. Continue development and demonstration of advanced material concepts and processes for thermal management applications.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop nonstructural materials for fluids, lubricants, aircraft topcoat and corrosion resistant coatings, and specialty treatments to improve system performance and reduce life cycle costs. Note: This effort includes Congressional Add funding of $1.0 million in FY 2005 for Durable Hybrid Coatings for Aircraft Systems and $3.0 million in FY 2006 ($1.0 million for Durable Hybrid Coatings for Aircraft Systems, $1.0 million for Nanoparticle Materials Coatings Research, and $1.0 million Chrome-Free Environmentally Friendly Corrosion Protection for Aircraft).	9.436	12.122	8.693
(U)	In FY 2005: Fabricated candidate materials for use in electrostatic discharge control gap treatments. Refined the advanced analytical models that will be used to predict the optical properties of specialty coatings based on measured data. Developed non-chromate surface treatments with advanced performance coatings for aircraft corrosion protection systems. Developed environmentally friendly corrosion protection systems with a 30-year life expectancy. Designed and developed nanostructured multifunctional coatings to control friction and wear in extreme environments. Fabricated and tested surface treatments for friction, stiction, and wear control in micro-devices.			
(U)	In FY 2006: Evaluate candidate materials for use in electrostatic discharge control gap treatments. Validate the advanced analytical models that will be used to predict the optical properties of specialty coatings based on measured data. Demonstrate non-chromate surface treatments via flight test. Continue to develop environmentally friendly corrosion protection systems with a 30-year life expectancy. Continue to develop nanostructured multifunctional coatings to control friction and wear in extreme environments. Continue testing of surface treatments for friction, stiction, and wear control in micro devices.			
(U)	In FY 2007: Demonstrate candidate gap treatment materials on air vehicles. Complete validation of the advanced analytical models that will be used to predict the optical properties of specialty coatings based on measured data. Continue to demonstrate and validate the non-chromate surface treatments for aircraft corrosion protection systems. Formulate chrome-free primer for corrosion protection systems with a 30-year life expectancy. Validate multifunctional coatings on engineering components. Downselect surface treatment candidates for further development for friction, stiction, and wear control in micro devices.			
(U)				
(U)	CONGRESSIONAL ADD: Air Force Minority Leaders Program.	0.000	3.450	0.000
(U)	In FY 2005: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NUMBER AND TITLE 4347 Materials for Structures, Propulsion, and Subsystems

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Conduct Congressionally-directed effort for Air Force Minority Leaders Program.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Minority LEADERS Research Program.	0.000	1.774	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Minority LEADERS Research Program.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Nanomaterials Commercialization Center of Pennsylvania.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Nanomaterials Commercialization Center of Pennsylvania.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	71.274	74.572	45.264

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0603112F, Advanced Materials for Weapon Systems.									
(U) PE 0603211F, Aerospace Technology Dev/Demo.									
(U) PE 0603202F, Aerospace Propulsion Subsystems Integration.									
(U) PE 0603216F, Aerospace Propulsion and Power Technology.									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) This project has been									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4347 Materials for Structures, Propulsion, and Subsystems**

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

coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602102F Materials	PROJECT NUMBER AND TITLE: 4348 Materials for Electronics, Optics, and Survivability	

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4348	Materials for Electronics, Optics, and Survivability	21.763	19.260	18.119	12.630	13.324	13.466	13.612	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops materials technologies for surveillance and situational awareness systems and subsystems for aircraft and missile applications, including sensor, microwave, and infrared detection and countermeasures devices used for targeting, electronic warfare, and active aircraft protection. Materials for protection of aircrews, sensors, and aircraft from laser and high-power microwave directed energy threats are also developed. Electronic and optical materials are being developed to enable surveillance and situational awareness with faster operating speeds, greater tunability, higher power output, improved thermal management (including higher operating temperatures), greater sensitivity, and extended dynamic range. New materials are being developed to counter the most prominent laser threats and to respond to emerging and agile threat wavelengths without impairing mission effectiveness.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop, evaluate, and mature infrared (IR) detector materials and materials processing technologies to enable improved performance, affordability, and operational capability of Air Force surveillance, tracking, targeting, and situational awareness systems.	0.842	0.651	1.322

(U) In FY 2005: Continued development of complex IR detector materials that are responsive to multiple wavelengths within and between spectral bands. Validated the materials properties of complex IR detector materials that require control on an atomic level to structure their detection properties. Developed promising innovative nano-scale materials as potential IR materials for a broad range of Air Force sensing needs including the detection of chemical threats.

(U) In FY 2006: Provide prototype growth, characterization, and analyses of potential IR materials systems to determine unique properties of interest to Air Force users. Develop the process control to enable ordered growth of two-dimensional, abrupt compositional interfaces in multiple wavelength materials. Validate the optical properties of advanced IR materials by optical characterization and evaluation of complex IR detector materials that have been produced by atomic level control. Explore methods of controlling materials composition, shape, and size on a nano-scale level and validate by structural characterization.

(U) In FY 2007: Validate optical, structural, and electronic properties of innovative IR materials to determine their ability to provide unique IR detection properties of interest to the Air Force. Characterize and evaluate the utility of single element multispectral IR materials with responses to more than two discrete wavelengths. Investigate the potential for three-dimensional material growth to exploit unique detection properties of complex IR materials. Validate promising materials growth technologies for nano-scale IR detection materials.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4348 Materials for Electronics, Optics, and Survivability**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	MAJOR THRUST: Develop and demonstrate enabling materials technologies to enhance the survivability and mission effectiveness of Air Force sensors and viewing systems. Note: In FY 2007, efforts in this major thrust will merge into the survivability thrust below.	1.539	1.776	0.000
(U)	In FY 2005: Designed a representative brassboard protection system using liquid crystal-based tunable filters. Characterized the optical performance of high optical density, multiple-wavelength switchable filter stacks.			
(U)	In FY 2006: Develop photorefractive materials for passive protection applications and develop device concepts that utilize photorefractive materials. Optimize the performance of high optical density, multiple-wavelength switchable filter technology for Air Force applications.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate enabling materials technologies to enhance the safety, survivability, and mission effectiveness of aircrews, sensors, viewing systems, and related assets. Note: This effort includes Congressional Add funding of $1.0 million in FY 2005 for Non-Linear Optical Materials.	7.327	4.855	8.502
(U)	In FY 2005: Developed growth and processing techniques for nonlinear optical crystals for generating radiation at significantly higher energies. Characterized the performance of the optimized nonlinear absorbing materials in candidate host materials and document the test results obtained for the protection of personnel eyes and viewing systems.			
(U)	In FY 2006: Continue to characterize the performance of optimized nonlinear absorbing materials into device concepts for eye and sensor system protection.			
(U)	In FY 2007: Incorporate optimized nonlinear optical limiter materials for damage protection of eyes and sensor systems. Optimize photorefractive materials properties for Air Force passive protection applications. Incorporate switchable filter technology into device concepts for eye and sensor system protection.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate materials and process technologies for power generation, power control, and microwave components to provide improved performance, affordability, and operational capability for Air Force surveillance, tracking, targeting, situational awareness, and lethal and non-lethal weapon systems. Note: This effort includes Congressional Add funding of $8.9 million in FY 2005 ($2.6 million for Advanced Wide Bandgap Materials, $2.5 million for Gallium Nitrate RF Power Technology, $1.7 million for Advanced Silicon Carbide Device Technology, and $2.1 million for Advanced Magnetic Random Access Memory Modules) and $6.3 million in FY 2006 ($3.2 million for Power Electronics Reliability, $2.1 million for Large Area, APVT Materials for Hi-Powered Devices, and $1.0 million for Advanced Materials Deposition for Semiconductor).	12.055	10.894	8.295

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4348 Materials for Electronics, Optics, and Survivability**

(U) B. Accomplishments/Planned Program ($ in Millions) FY 2005 FY 2006 FY 2007

(U) In FY 2005: Enhanced specific baseline materials and materials processing technologies to enable increased Air Force systems reliability and temperature capability, while reducing power consumption, weight, cost, cooling, complexity, and size. Investigated advanced materials and materials processing technologies to provide capabilities beyond those achievable with baseline materials. Optimized and scaled up materials and materials processes to provide presently unattainable performance for power control systems, advanced radar, and electronic countermeasures. Completed assessment of baseline materials and materials process technologies for ultra-lightweight, ultra-high-power aircraft electrical generators enabling airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft. Developed advanced materials and materials process technologies to provide improvements and additional capabilities relative to baseline materials/processes. Developed and analyzed materials and materials process technologies for Terahertz components to provide the bandwidth required for the next order of magnitude leap in speed of Air Force sensor and communication systems.

(U) In FY 2006: Demonstrate scale-up of materials and materials processes for power control systems, advanced radar, and electronic countermeasures. Continue development of advanced materials and materials process technologies to enable airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft, and an order of magnitude improvement in speed for Air Force sensor and communication systems. Demonstrate scale-up of materials and materials processes to provide presently unattainable performance for power control systems, advanced radar, and electronic countermeasures. Continue development of advanced materials and materials process technologies to provide improvements and additional capabilities relative to baseline materials/processes for ultra-lightweight, ultra-high-power aircraft electrical generators enabling airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft. Continue development of materials and materials process technologies for Terahertz components supporting order of magnitude improvement in speed for Air Force sensor and communication systems. Identify most promising materials approaches for application to initial prototype evaluation.

(U) In FY 2007: Demonstrate capabilities of advanced materials and materials process technologies to enable airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft. Validate and demonstrate selected materials and materials process technologies for use in Terahertz components. Continue to demonstrate scale-up of materials and materials processes to provide presently unattainable performance for power control systems, advanced radar, and electronic countermeasures. Demonstrate capabilities of advanced materials and materials process technologies to provide improvements and additional capabilities relative to baseline materials/processes for ultra-lightweight, ultra-high-power aircraft electrical generators enabling airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft. Validate and demonstrate selected materials and materials process technologies for use in Terahertz components, supporting high speed communications and advanced sensors.

(U)

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4348 Materials for Electronics, Optics, and Survivability**

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
(U) CONGRESSIONAL ADD: Engineered Optical Materials for High Energy Laser Development.	0.000	1.084	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Conduct Congressionally-directed effort for Engineered Optical Materials for High Energy Laser Development.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	21.763	19.260	18.119

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0603112F, Advanced Materials for Weapon Systems.									
(U) PE 0602202F, Human Effectiveness Applied Research.									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603231F, Crew Systems and Personnel Protection Technology.									
(U) PE 0603211F, Aerospace Technology Dev/Demo.									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602102F Materials	PROJECT NUMBER AND TITLE: 4349 Materials Technology for Sustainment	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4349	Materials Technology for Sustainment	17.365	16.817	18.417	17.516	18.456	18.631	18.774	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops materials and materials processing technologies to support operational Air Force mission areas by providing the ability to inspect the quality of delivered systems, transitioning more reliable and maintainable materials, establishing a capability to detect and characterize performance threatening defects, characterizing materials processes and properties necessary for materials transition, and providing quick reaction support and failure analysis to the operational commands and repair centers. Repair techniques and nondestructive inspection/evaluation (NDI/E) methods are developed that are needed for metallic and non-metallic structures, coatings, corrosion control processes, and to support integration of composite structures for aerospace systems. Various NDI/E methods are essential to ensure optimum quality in the design and production of aircraft, propulsion, and missile systems. These NDI/E methods are also essential to monitor and detect the onset of any service-initiated damage and/or deterioration due to aging of operational systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop NDI/E technologies to identify and characterize damage in aging aerospace structures, propulsion systems, and complex, low-observable (LO) materials and structures.	3.691	3.693	5.806

(U) In FY 2005: Evaluated electromagnetic methods to rapidly detect and characterize multi-site damage and cracks in large area, aging structures. Evaluated computer simulations and models of NDI/E technique response, which will enable the development of improved inspections in a virtual environment to permit the depots to rapidly assess the potential of new corrosion and crack detection NDI/E methods. Developed sensor technologies for measuring complex electromagnetic material properties beneath dielectric tiles. Developed a residual stress gradient measurement capability for selected turbine engine materials for shot peened surfaces.

(U) In FY 2006: Demonstrate electromagnetic technology to detect and characterize multi-site damage and cracks in large area, aging structures. Develop computer simulations and models of NDI/E technique response to enable rapid assessment of multiple NDI/E technologies for depot level inspections. Initiate efforts to explore and develop NDI/E technologies for inspection of thick (multi-layer) aging aircraft structures with complex geometries. Evaluate feasibility of advanced LO NDI/E methods and systems for use in battle damage assessment and for inspection following battle damage repair. Transition sensor technology for measuring complex electromagnetic material properties beneath dielectric tiles.

(U) In FY 2007: Continue to develop computer simulations and models of NDI/E technique response to enable rapid assessment of multiple NDI/E technologies for depot level inspections. Develop NDI/E technologies for inspection of thick (multi-layer) aging aircraft structures with complex geometries. Develop advanced LO NDI/E methods and systems for use in battle damage assessment and for inspection following battle damage repair.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NUMBER AND TITLE 4349 Materials Technology for Sustainment

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	MAJOR THRUST: Develop support capabilities, information, and processes to resolve problems with materials in the repair of aircraft structures and to reduce aircraft corrosion.	5.795	5.066	7.110
(U)	In FY 2005: Matured methodologies to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Evaluated methodologies to test failure limits for MEMS structures and subsystems. Developed specification for laser additive manufacturing of non flight-critical parts. Demonstrated effectiveness of low plasticity burnishing of landing gear components. Assessed effectiveness of corrosive preventative compounds for various Air Force applications.			
(U)	In FY 2006: Apply methodologies to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Continue to evaluate methodologies to test failure limits for MEMS structures and subsystems. Evaluate effects of defects in laser additive manufactured parts.			
(U)	In FY 2007: Continue to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Continue to evaluate methodologies to test failure limits for MEMS structures and subsystems. Validate effects of defects in laser additive manufactured parts.			
(U)				
(U)	MAJOR THRUST: Develop support capabilities, information, and processes to resolve materials problems and provide electronic and structural failure analysis of components.	3.936	4.050	4.712
(U)	In FY 2005: Performed failure analysis and materials investigations for field, acquisition, and depot organizations. Developed electrostatic discharge protection technologies for emerging avionics subsystems. Validated new test methodologies for analyzing structural failures of replacement materials for aging Air Force systems. Developed materials technologies effort to replace aging wiring in Air Force aircraft subsystems.			
(U)	In FY 2006: Continue performing failure analysis and materials investigations for field, acquisition, and depot organizations. Demonstrate electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Evaluate new test methodologies for analyzing structural failures of emerging materials for Air Force systems. Evaluate wiring materials technologies to replace aging wiring systems and new wiring technologies for emerging weapons systems.			
(U)	In FY 2007: Continue performing failure analysis and materials investigations for field, acquisition, and depot organizations. Continue demonstration of electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Validate new test methodologies for analyzing structural failures of emerging materials for Air Force systems. Evaluate/validate wiring materials technologies to replace aging wiring systems and new wiring technologies for emerging weapons systems.			
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NUMBER AND TITLE 4349 Materials Technology for Sustainment

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST: Develop enabling technologies to reduce the Air Force LO maintenance burden.	3.943	4.008	0.789
(U)	In FY 2005: Optimized technologies for an integrated, standardized LO repair kit that includes conductive gap fillers, radar absorbing material (RAM) repair materials, RAM removal equipment, radar absorbing structure (RAS) repair materials, and NDI/E equipment and software.			
(U)	In FY 2006: Develop multispectral/multipurpose tool for inspection of LO systems on aircraft. Investigate program for improved maintainability of advanced LO materials and designs including conductive outer-mold-line, applique, door edges and seals, multifunctional systems, and embedded LO NDI/E.			
(U)	In FY 2007: Develop technologies for improved maintainability of advanced LO materials and designs, such as conductive outer-mold-line, applique, door edges and seals, multifunctional systems, and embedded LO NDI/E.			
(U)	Total Cost	17.365	16.817	18.417

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0603112F, Advanced Materials for Weapons Systems.									
(U) PE 0603211F, Aerospace Technology Dev/Demo.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT NUMBER AND TITLE: 4915 Deployed Air Base Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4915 Deployed Air Base Technology	7.058	10.802	2.662	2.552	2.701	2.732	2.761	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the FY 2006 Congressionally-directed Carbon Nanostructured Material for Fluid Purification in the amount of $5.0 million are in the process of being moved to PE 0602202F, Human Effectiveness Applied Research, from PE 0602102F, Materials, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops new deployable airbase technologies to reduce airlift and manpower requirements, setup times, and sustainment costs, and to improve protection and survivability of deployed Air Expeditionary Force (AEF) warfighters. Affordable, efficient technologies are developed for base infrastructure, fire fighting, and force protection to improve deployed operations.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop new deployable airbase technologies to reduce airlift and manpower requirements, setup times, and sustainment costs in support of AEF operations.	1.211	1.261	1.382
(U) In FY 2005: Developed high-efficiency, solid state solar cell technology. Developed advanced heat and mass transfer technologies and thin film catalytic technologies to improve deployed energy system performance. Developed an advanced work-recovery rotary expansion device to improve deployed air conditioning performance. Developed polymer-clay stabilization agents for rapid airfield expansion that will reduce time to prepare aircraft operating surfaces. Evaluated catalysis and degradation technologies to provide cleaner, lower cost advanced materials.			
(U) In FY 2006: Investigate fabrication techniques to integrate solid state solar cell technology into deployable shelter fabrics. Continue to develop advanced heat and mass transfer technologies and thin film catalysis for logistic fuel processing planar technology. Continue to develop an advanced work-recovery rotary expansion device to improve deployed air conditioning performance. Demonstrate polymer-clay stabilization agents for rapid airfield expansion. Refine ground penetrating radar interpretation capability to improve man-portable rapid airfield assessment. Develop biomaterials that produce similar effects as chemical catalysts for improved reactive production of aerospace materials.			
(U) In FY 2007: Develop high-efficiency solar shelter fabrics. Continue development of advanced heat and mass transfer technologies and demonstrate logistic fuel processing planar technology. Investigate behavior of soil and stabilizer interaction with airfield matting and begin model development. Develop non-radar wave methods of nondestructive inspection of airfield surface anomalies. Synthesize polymer materials using biocatalysts and reagents for producing reduced cost, tailored characteristics in aerospace materials.			
(U)			
(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop affordable technologies to provide force protection and	5.847	4.612	1.280

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NUMBER AND TITLE 4915 Deployed Air Base Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	survivability to AEF deployed warfighters and infrastructure. Note: This effort includes Congressional Add funding of $4.5 million in FY 2005 ($2.4 million for Blast Resistant Barriers for Homeland Defense and $2.1 million for Thermal Sprays for Structural Protection) and $1.7 million in FY 2006 ($1.7 million for Blast Resistant Barriers for Homeland Defense and $2.1 million for Thermal Sprays for Structural Blast Mitigation).			
(U)	In FY 2005: Developed more effective fire fighting agents and application methodologies for protection of warfighters. Developed technologies for increased firefighter situational awareness, improved synergy, and greater on-site duration. Initiated research on resilient infrastructure technologies for more effective protection of structures and inhabitants. Characterized ballistic and fragmentation aspects of improvise explosive device threats for development of protective measures. Characterized the atmospheric and surface action and interaction of asymmetric threat agents for protection of aerospace warfighters and equipment.			
(U)	In FY 2006: Develop fire fighting agents with increased versatility by combining agents and application methodologies. Continue developing technologies for increased fire fighter situational awareness, improved synergy, and greater on-site duration. Continue research on resilient infrastructure technologies for more effective protection of structures and inhabitants. Develop technologies to protect against the ballistic and fragmentation effects of improvised explosive device threats and characterize high energy weapons threats. Model atmospheric and surface phenomenon of in-theater chemicals and asymmetric threats for tailored response protection.			
(U)	In FY 2007: Demonstrate emerging fire suppression technologies for integrated crash/rescue capability. Integrate individual fire fighter effectiveness technologies for a combined technology demonstration. Demonstrate resilient structural materials and methodologies for improved protection of structures and inhabitants. Continue developing technologies to protect against the ballistic and fragmentation effects of improvised explosive device threats, and initiate protective material development against high energy threats. Develop characterization data for atmospheric models for protection of deployed warfighters from asymmetric threats.			
(U)				
(U)	CONGRESSIONAL ADD: Carbon Nanostructured Material for Fluid Purification.	0.000	4.929	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Initiate Congressionally-directed effort for Carbon Nanostructured Material for Fluid Purification.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	7.058	10.802	2.662

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NUMBER AND TITLE 4915 Deployed Air Base Technology

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0603112F, Advanced Materials for Weapon Systems.

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

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0602201F
PE TITLE: Aerospace Vehicle Technologies

Exhibit R-2, RDT&E Budget Item Justification

DATE: **February 2006**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602201F Aerospace Vehicle Technologies**

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	75.195	104.469	112.751	106.517	111.837	113.689	115.123	Continuing	TBD
22SP	Applied Space Access Vehicle Tech	0.000	0.000	3.811	7.989	7.456	7.758	7.695	Continuing	TBD
2401	Structures	29.569	40.420	46.311	37.611	42.000	42.618	43.204	Continuing	TBD
2403	Flight Controls and Pilot-Vehicle Interface	17.526	35.197	33.011	27.309	29.157	29.596	30.026	Continuing	TBD
2404	Aeromechanics and Integration	28.100	28.852	29.618	33.608	33.224	33.717	34.198	Continuing	TBD

Note: Funds for FY 2006 Congressionally-directed Unmanned Systems Initiative at Army Missile Research, Development, Engineering Center (AMRDEC) in the amount of $2.4 million are in the process of being moved to PE 0602303A, Missile Technology, from PE 0602201F, Aerospace Vehicle Technologies, for execution. In FY 2007, Project 6266SP, Applied Space Access Vehicle Technology, efforts were transferred from PE 0602500F, Multidisciplinary Space Technology, Project 625030, Applied Space Access Vehicle Technology, in order to effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This program investigates, develops, and analyzes aerospace and access to space vehicle technologies in the three primary areas of structures, controls, and aeromechanics. Advanced structures concepts are explored and developed to exploit new materials, fabrication processes, and design techniques. Flight control technologies are developed and simulated for aerospace vehicles. Advanced aerodynamic vehicle configurations are developed and analyzed through simulations, experiments, and multi-disciplinary analysis. Resulting technologies reduce life cycle costs and improve the performance of existing and future manned and unmanned aerospace vehicles. Note: In FY 2006, Congress added $1.0 million for the Intelligent Flight Control Simulation Research Laboratory, $1.4 million for the Unique Stealth Unmanned Air Vehicle Houck Aircraft Design program, $1.7 million for Sentient Adaptive Systems for Rapid Vehicle Condition-Based Maintenance, $1.7 million for Modeling and Simulation for Rapid Integration and Technology Evaluation, $2.5 million for Unmanned Systems Initiative at AMRDEC, and $1.0 million for Wight Brothers Institute (WBI) - Characterization of Airborne Environment for Tactical Lasers. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary aerospace vehicle technologies.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602201F Aerospace Vehicle Technologies**

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	76.401	96.679	104.229
(U)	Current PBR/President's Budget	75.195	104.469	112.751
(U)	Total Adjustments	-1.206	7.790	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.059	-1.510	
	Congressional Increases		9.300	
	Reprogrammings	-0.095		
	SBIR/STTR Transfer	-1.052		
(U)	Significant Program Changes:			

Not Applicable.

(U) C. Performance Metrics

Under Development

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602201F Aerospace Vehicle Technologies**	**22SP Applied Space Access Vehicle Tech**

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
22SP	Applied Space Access Vehicle Tech	0.000	0.000	3.811	7.989	7.456	7.758	7.695	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, Project 6266SP, Applied Space Access Vehicle Technology, efforts were transferred from PE 0602500F, Multidiscipliary Space Technology, Project 625030, Applied Space Access Vehicle Technology, in order to effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops technologies in areas of advanced structures, flight controls, and aerodynamics to enable affordable on-demand military access to space. Resulting technologies contribute significantly towards the development of reliable, responsive space access systems with aircraft-like operations. Payoffs to the warfighter include enhanced mission effectiveness, improved flight safety, improved maintenance, and decreased size, weight, and cost.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop advanced structure, flight control, and aerodynamic technologies to enable horizontal launch for affordable on-demand military access to space.	0.000	0.000	3.811
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Further define and develop integrated guidance and control laws to expand the launch vehicle performance envelope.			
(U) Total Cost	0.000	0.000	3.811

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activies:									
(U) PE 0603211F, Aerospace Technology Dev/Demo.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE: 2401 Structures	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2401 Structures	29.569	40.420	46.311	37.611	42.000	42.618	43.204	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops advanced structures concepts to exploit new materials and fabrication processes and investigates new structural concepts and design techniques. New structural concepts include incorporating subsystem hardware items (e.g., antennas, sensors, directed energy weapon components, and integrated energy storage) and adaptive mechanisms into the actual aircraft structures and/or skin of the aircraft. Resulting technologies strengthen and extend the life of current and future manned and unmanned aerospace vehicle structures, while providing increased capabilities. Payoffs to the warfighter include reduced weight and cost, as well as improved operability and maintainability of aerospace vehicles.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop an economic service life analysis capability comprised of analysis tools, methodologies, and structural health monitoring schemes. Note: Decrease in FY 2006 and out is due to reduction of related sustainment efforts in PE 0603211F.	5.707	2.310	2.120
(U) In FY 2005: Continued to develop alternative methodologies and concepts for structural repair. Developed structural health monitoring schemes for structures susceptible to damage. Pursued additional aspects of the development of economic service life analysis and structural design tools for current and future aircraft enhancing capabilities, component replacement, and technology direction. Incorporated newly developed analysis tools for life prediction and failure analysis. Continued to develop failure criteria tools for advanced high temperature aircraft components and concepts. Completed the development of unitized structural concepts and multi-disciplinary methodologies that enhance affordability and decrease vulnerability for current and future aerospace vehicles.			
(U) In FY 2006: Continue to pursue additional aspects of the development of economic service life analysis and structural design tools for current and future aircraft, enhancing capabilities, component replacement, and technology direction. Incorporate newly developed analysis tools into life prediction and failure analysis. Continue to refine failure criteria tools for advanced high temperature aircraft components and concepts.			
(U) In FY 2007: Continue development of structural health management schemes for structures susceptible to damage. Continue the development of economic service life analysis and structural design tools for current and future aircraft, enhancing capabilities, component replacement, and technology direction. Incorporate newly developed analysis tools into life prediction and failure analysis. Continue to develop failure criteria tools for advanced high temperature aircraft components and concepts.			
(U)			
(U) MAJOR THRUST: Develop methodologies to allow for analytical airworthiness certification that will reduce the	5.914	7.136	7.293

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2401 Structures

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	cost and time involved in actual full-scale testing of components and aircraft prior to obtaining airworthiness certification.			
(U)	In FY 2005: Continued to develop analytical certification methodologies for the incorporation of advanced methods, concepts, diagnostic techniques, and manufacturing technologies into legacy aircraft components and airframe design. Improved airworthiness certification process for aircraft subject to dynamic loads and with high fidelity.			
(U)	In FY 2006: Continue development of medium- and high-fidelity, and real-time analytical certification methodologies that improve airworthiness certification process and reduce development and testing for aircraft and components subject to dynamics loads.			
(U)	In FY 2007: Continue development of analytical certification methodologies that incorporate advanced methods, concepts, diagnostic techniques, and manufacturing technologies into legacy aircraft components and airframe design. Complete development of medium- and high-fidelity, and real-time analytical certification methodologies that improve airworthiness certification process and reduce development and testing for aircraft and components subject to dynamics loads.			
(U)				
(U)	MAJOR THRUST: Develop design methods to capitalize on new materials and integration of various subsystem hardware items (e.g., antennas, sensors, direct energy weapon components, and integrated energy storage) and adaptive mechanisms into the actual aircraft structures and/or skin of the aircraft. Note: In FY 2006 and out, funding increased due to initiation of full-scale feasibility determination of air vehicle monitoring in advanced structures. Efforts in this thrust are integrated with efforts in Project 2403 for advanced flight controls, components, and integrated vehicle health monitoring.	4.879	13.826	19.617
(U)	In FY 2005: Continued refinement concepts, design and analysis methods, and components that enable the integration of structures with other air vehicle functions to reduce cost and weight, as well as increase the survivability of future systems. Continued the development of concepts that include adaptive structures, subsystem hardware, and antenna integration into a load-bearing structure to create multi-function or ultra-lightweight concepts.			
(U)	In FY 2006: Continue development and initiate evaluation and assessment of design and analysis methods and components that enable the integration of structures with other air vehicle functions to reduce cost and weight, as well as increase the survivability and performance of future systems. Initiate the development and analysis of critical subsystem hardware integration methods to enable directed energy weapons to be carried out on future air vehicles. Complete analysis and continue feasibility determination of energy storage concepts that are integrated into load-bearing structures. Continue the development and initiate evaluation, assessment, and ground evaluation of adaptive structures and antenna integration concepts into load-bearing structures to create multi-function or ultra-lightweight concepts.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2401 Structures

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Continue the development, evaluation, and assessment of design and analysis methods and components that enable the integration of structures with other air vehicle functions to reduce cost and weight, as well as increase the survivability and performance of future systems. Continue the development, evaluation, assessment, and ground testing of adaptive structures, subsystem hardware, and antenna integration into load-bearing structures to create multi-function or ultra-lightweight concepts. Complete feasibility determination efforts of energy storage concepts that are integrated into load-bearing structures. Complete the development and analysis, and initiate evaluation and testing of critical subsystem hardware integration methods that enable directed energy weapons to be carried out on future air vehicles. Initiate development, analysis, and evaluation of innovative technologies that integrate active aeroelastic design concepts, adaptive structures, and aerodynamic flow control technologies to enable viable long-range and long endurance air vehicle concepts.			
(U)				
(U)	MAJOR THRUST: Develop technologies that will permit the structural development of aircraft that can operate at an extreme altitude, while at sustained speeds greater than Mach 2. Note: In FY 2006 and out, funding increased due to increased emphasis placed on air vehicle structures for high-speed vehicles.	13.069	17.148	17.281
(U)	In FY 2005: Continued to develop technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Continued the development of concepts germane to advanced, all-weather, durable, thermal protection systems; attachment techniques; vehicle health monitoring; joining concepts; and tanks.			
(U)	In FY 2006: Refine the development of technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Technologies will improve durability of existing and future aerospace vehicle structures resulting in reduced cost and increased life. Continue the development of concepts germane to advanced, all weather, durable, thermal protection systems; attachment techniques; vehicle health management; joining concepts; and tanks.			
(U)	In FY 2007: Further develop technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Technologies will improve durability of existing and future aerospace vehicle structures resulting in reduced cost and increased life. Complete development of concepts germane to advanced, all weather, durable, thermal protections systems; attachment techniques; vehicle health management; hot primary structures; hybrid structures; joining concepts; and tanks.			
(U)				
(U)	Total Cost	29.569	40.420	46.311

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602201F Aerospace Vehicle Technologies**	PROJECT NUMBER AND TITLE **2401 Structures**

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602102F, Materials.

(U) PE 0603112F, Advanced Materials for Weapon Systems.

(U) PE 0603211F, Aerospace Technology Dev/Demo.

(U) PE 0604015F, Next Generation Bomber.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE: 2403 Flight Controls and Pilot-Vehicle Interface	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2403	Flight Controls and Pilot-Vehicle Interface	17.526	35.197	33.011	27.309	29.157	29.596	30.026	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006 and out, increased funding is due to increased emphasis being placed on incorporating data from air vehicle monitoring components into flight controls. Funds for FY 2006 Congressionally-direct Unmanned Systems Initiative at Army Missile Research, Development, Engineering Center (ARMDEC) in the amount of $2.4 million are in the process of being moved to PE 0602303A, Missile Technology, from PE 0602201F, Aerospace Vehicle Technologies, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops technologies that enable maximum affordable capability from manned and unmanned aerospace vehicles. Advanced flight control technologies are developed for maximum vehicle performance throughout the flight envelope and simulated in virtual environments. Resulting technologies contribute significantly towards the development of reliable autonomous unmanned air vehicles, space access systems with aircraft-like operations, and extended-life legacy aircraft. Payoffs to the warfighter include enhanced mission effectiveness, optimized flight safety, increased survivability, improved maintenance, and decreased size, weight, and cost. Leverages a network of synthetic environments for evaluation of advanced concepts.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop advanced flight control systems, components, and integrated vehicle health monitoring systems for both manned and unmanned aircraft. In addition to increased reliability, efforts will also focus on reducing the size, weight, and cost of control and prognostic systems. Note: Increased funding in FY 2006 and out, is due to increased emphasis being placed on incorporating data from air vehicle monitoring components into the flight control systems.	7.010	13.533	16.270

(U) In FY 2005: Continued to develop and assess advanced control mechanization to provide highly reliable operations for manned and unmanned systems at reduced size, weight, and cost. Developed and assessed tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Continued to develop design analyses and technologies that enable analytical safety of flight certification of advanced complex control systems for applications in legacy and future air vehicles. Continued evaluation of sensing and associated interpretation techniques for unmanned system situational awareness in airspace operations. Continued to enhance real-time fault compensation for aerospace vehicles using an integrated prognostic health management system. Initiated the development and evaluation of novel flight control effectors for distributed actuation and morphing aerospace vehicles.

(U) In FY 2006: Further the development and assessment of advanced control mechanization technologies to provide highly reliable operations for manned and unmanned systems under adverse environments at significantly reduced size, weight, and cost. Develop high-density optical component technologies for adverse environments that reduce

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicle Interface

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	subsystem size, weight, and cost while considering maintainability. Design systems for safety-critical control using high-density optical components. Continue to develop and assess tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Develop technologies and analysis tools to extend design-time verification and validation of intelligent, autonomous, and reconfigurable control systems for enhanced assurance. Continue the evaluation of sensing and associated interpretation techniques for unmanned system situational awareness in airspace operations. Continue to enhance real-time fault compensation for aerospace vehicles using integrated health management. Continue the development and evaluation of novel flight control effectors for distributed actuation and morphing aerospace vehicles.			
(U)	In FY 2007: Further the development and assessment of advanced control mechanization technologies to provide highly reliable operations for manned and unmanned systems under adverse environments at significantly reduced size, weight, and cost. Develop high-density optical component technologies for adverse environments that reduce subsystem size, weight, and cost while considering maintainability. Design systems for safety-critical control using high-density optical components. Continue to develop and assess tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Refine technologies and analysis tools for reconfigurable control systems. Complete the evaluation of sensing and associated interpretation techniques for unmanned system situational awareness in aerospace operations. Refine technologies that permit integrated vehicle health management.			
(U)				
(U)	MAJOR THRUST: Develop flight control systems that will permit safe interoperability between manned aircraft and unmanned aircraft. Concepts will also provide mission responsiveness and adaptability for improved operational effectiveness of manned and unmanned systems. Note: In FY 2006 and out, increased funding is due to increased emphasis being placed on developing flight controls for small air platforms operating in an urban environment.	3.593	6.436	9.783
(U)	In FY 2005: Continued efforts to develop and assess novel control automation techniques and algorithms to enable safe and interoperable applications of unmanned vehicle systems. Continued efforts to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Continued development of intelligent situational awareness algorithms to implement autonomous airspace operations control for unmanned vehicle systems.			
(U)	In FY 2006: Assess novel control automation techniques and adaptive algorithms to enable safe and interoperable application of manned and unmanned aerospace systems. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations.			
(U)	In FY 2007: Continue to develop and assess novel control automation techniques and adaptive algorithms to enable safe and interoperable application of manned and unmanned aerospace systems. Continue to enhance reliability and			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicle Interface

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Initiate development and assessment of cooperative control techniques for close-in surveillance of urban environments. Initiate control and situational awareness requirements development for interoperability of unmanned vehicles in terminal area and ground operations.			
(U)				
(U)	MAJOR THRUST: Develop tools and methods for capitalizing on simulation-based research and development of future aircraft.	5.661	8.429	6.958
(U)	In FY 2005: Refined efforts to assess the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems, and processes for simulation-based research and development. Conducted simulation assessments of advanced manned and unmanned aerospace vehicles concepts. Completed the enhancement of simulation and analysis capabilities through incorporation of cost models to determine the affordability of new technologies. Completed the development of the virtual simulation environment for future strike aircraft. Continued to formulate and simulate concepts for future intelligence, surveillance, and reconnaissance platforms, future high-speed vehicles, advanced transports, and future tankers.			
(U)	In FY 2006: Conduct assessments of advanced manned and unmanned aerospace concepts in simulated future environments. Conduct analysis of future strike concepts in a 2020+ virtual environment. Continue analysis of long endurance intelligence, surveillance, and reconnaissance platforms in a network centric environment. Continue to support simulation activities for advanced transports and future tankers. Support the analysis of new concepts in hostile urban environments and missions requiring aircraft-like access to space.			
(U)	In FY 2007: Complete assessments of advanced manned and unmanned aerospace concepts in simulated future environments. Complete analysis of long endurance intelligence, surveillance, and reconnaissance platforms in a network centric environment. Conduct technology trade studies for next generation theater transports. Conduct the analysis of new concepts in access to space missions. Conduct analyses of new concepts in hostile urban environments.			
(U)				
(U)	CONGRESSIONAL ADD: Intelligent Flight Control Simulation Research.	1.262	0.986	0.000
(U)	In FY 2005: Continued Congressionally-directed effort for intelligent flight control simulation research laboratory.			
(U)	In FY 2006: Continue Congressionally-directed effort for intelligent flight control simulation research laboratory.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Sentient Adaptive Systems Technology for Vehicle Condition-Based Maintenance.	0.000	1.676	0.000
(U)	In FY 2005: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicle Interface

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Initiate Congressionally-directed effort for sentient adaptive systems technology for vehicle condition-based maintenance.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Modeling and Simulation for Rapid Integration and Technology Evaluation.	0.000	1.676	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Initiated Congressionally-directed effort for rapid integration and technology evaluation.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Unmanned Systems Initiative for Army Missile Research, Development, Engineering Center (AMRDEC).	0.000	2.461	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Initiated Congressionally-directed effort for unmanned systems initiative for AMRDEC.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	17.526	35.197	33.011

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602202F, Human Effectiveness Applied Research.									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603211F, Aerospace Technology Dev/Demo.									
(U) PE 0604015F, Next Generation Bomber.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicle Interface

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE: 2404 Aeromechanics and Integration

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2404 Aeromechanics and Integration	28.100	28.852	29.618	33.608	33.224	33.717	34.198	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops aerodynamic configurations of a broad range of revolutionary, affordable air vehicles. It matures and applies modeling and numerical simulation methods for fast and affordable aerodynamics prediction, and integrates and demonstrates multi-disciplinary advances in airframe, propulsion, weapon, and air vehicle control integration. Technologies developed will greatly enhance warfighter capability in aircraft, missiles, and high-speed aerospace vehicles. The payoffs from these technology programs include lower vehicle costs (both production, and operations and support costs), increased payload and range capability, and improved supportability, safety, and survivability of aerospace vehicles.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop aerodynamic prediction efforts centered on expanding the design capabilities of manned and unmanned air vehicles. Note: In FY 2006, efforts for both manned and unmanned air vehicles were combined in this Major Thrust.	2.782	3.462	3.402

(U) In FY 2005: Continued efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions, including offensive missions, to reduce life cycle costs and decrease human risk. Continued to perform mission assessment and develop low-cost unmanned air vehicle concept to perform tactical surveillance and weapon delivery. Continued to apply flow control techniques to complex air vehicle designs to achieve reduced drag and improved propulsion system performance. Initiated research into rapid prototyping and analysis techniques to support virtual and physical models. Continued to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles.

(U) In FY 2006: Continue efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions, including offensive missions, to reduce life cycle costs and decrease human risk. Evaluate the application of flow control techniques to complex air vehicle designs to achieve reduced drag and improved propulsion system performance. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles.

(U) In FY 2007: Continue efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions, including offensive missions, to reduce life cycle costs and decrease human risk. Continue to perform mission assessment and develop low-cost unmanned air vehicle concept to perform tactical surveillance and weapon delivery. Initiate development and evaluation of flow control techniques to complex air vehicle designs to achieve reduced drag and improved propulsion system performance on low speed vehicles. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2404 Aeromechanics and Integration

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
vehicles.			
(U)			
(U) MAJOR THRUST: Develop new and improved concepts, designs, and analysis of technologies to enable revolutionary capabilities for sustained high-speed flight and re-useable high altitude aerospace vehicle efforts. Note: In FY 2005, reuseable, high altitude aircraft efforts were broken out for increased visibility between high-speed and reuseable, high altitude aircraft efforts. In FY 2006 and out, increased emphasis has been placed on assessing the next generation long-range, high-speed air vehicle concepts.	9.469	13.260	16.484
(U) In FY 2005: Developed and assessed aerospace technologies that enable sustained high-speed (greater than Mach 2) flight to permit global reach. Continued development of integrated airframe propulsion design concepts for high-speed aerospace vehicles. Developed analytic methods for modeling the plasma flow field over high-speed vehicles to reduce drag. Continued development of techniques to carry and deploy weapons from aerospace vehicles operating at high speeds (greater than Mach 2) and high temperatures.			
(U) In FY 2006: Continue development and assessment of aerospace technologies that enable sustained high-speed flight to permit global reach. Continue development of integrated airframe propulsion design concepts for high-speed aerospace vehicles. Conduct computational aerodynamic analysis and sub-scale aerodynamic testing of advanced inlet boundary layer flow control techniques, secondary flow devices, and high-speed inlet apertures. Conduct computational aerodynamic analysis of high performance vectoring exhaust nozzles. Continue development of analytic methods for modeling the plasma flow field over high-speed vehicles to significantly reduce drag. Conduct computational aerodynamic analysis of high efficiency wing-body aero configurations including advanced flight control techniques.			
(U) In FY 2007: Continue development and assessment of aerospace technologies that enable sustained high-speed flight to permit global reach. Continue development of integrated airframe propulsion design concepts for high-speed aerospace vehicles. Conduct sub-scale aerodynamic testing of integrated inlet concepts on high efficiency aero configurations for system level performance validation. Develop and analyze thermally integrated structures for lightweight integrated exhaust systems and airframes. Conduct high fidelity aerodynamic testing of advance control techniques for low speed and high-speed operation. Develop analytical stability and control simulations to verify system level operability. Complete development of analytic methods for modeling the plasma flow field over high-speed vehicles to significantly reduce drag			
(U)			
(U) MAJOR THRUST: Develop new and improved concepts, designs, and analysis of technologies to enable revolutionary capabilities for re-useable, high altitude aircraft. Note: In FY 2005, the reuseable, high altitude aircraft efforts previously described in the above related Major Thrust area were broken out to allow for increased visibility	7.812	3.663	1.842

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2404 Aeromechanics and Integration

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	between high-speed and reuseable, high altitude aircraft efforts. The FY 2006 and FY 2007 efforts will be leveraging the results of the high-speed Major Thrust area previously listed above.			
(U)	In FY 2005: Developed and assessed aerospace technologies that enable high-speed flight to permit reuseable, high altitude aircraft operations. Continued development of computational, multi-disciplinary, experimental, and analytical tools to simulate and control the flow fields around advanced concepts for ultra-high-speed aerospace vehicles in extreme flight environments, including staging. Developed techniques to evaluate transatmospheric vehicle aerodynamic configurations to validate aero thermodynamic predictions and analysis techniques.			
(U)	In FY 2006: Continue development and assessment of aerospace technologies that enable high-speed flight to permit reuseable, high altitude aircraft. Continue development and initiate evaluation of computational, multi-disciplinary, experimental, and analytical tools to simulate and control the flow fields around advanced concepts for ultra-high-speed aerospace vehicles in extreme flight environments. Continue and evaluate development of techniques to evaluate transatmospheric vehicle aerodynamic configurations to validate aero thermodynamic predictions and analysis techniques.			
(U)	In FY 2007: Develop and assess aerospace technologies that enable reuseable, high altitude aircraft. Complete development and evaluation of computational, multi-disciplinary, experimental, and analytical tools to simulate and control the flow fields around advanced concepts for ultra-high-speed aerospace vehicles in extreme flight environments, including staging. Complete development of techniques to evaluate transatmospheric vehicle aerodynamic configurations to validate aero thermodynamic predictions and analysis techniques.			
(U)				
(U)	MAJOR THRUST: Develop enabling technologies to allow integration of directed energy weapons into current and future air vehicle platforms. Note: In FY 2006 and out, investment is decreasing pending further development of directed energy applications.	4.412	2.544	1.789
(U)	In FY 2005: Developed and evaluated critical aeronautical technologies to enable directed energy weapons to be carried on future air vehicles, including maneuvering fighter aircraft, to improve combat effectiveness. Continued analysis of the tactical utility a high energy laser on fighter aircraft. Continued measurements of the actual aero-optics effects encountered when employing a laser weapon on a fighter aircraft.			
(U)	In FY 2006: Continue development and evaluation of critical aeronautical technologies that enable directed energy weapons to be carried on future air vehicles, including maneuvering fighter aircraft, to improve combat effectiveness. Complete analysis of tactical utility of high energy laser on fighter aircraft. Continue measurements of the actual aero-optics effects encountered when employing a laser weapon on a fighter aircraft.			
(U)	In FY 2007: Complete development and evaluation of critical aeronautical technologies that enable directed energy weapons to be carried on future air vehicles, including maneuvering fighter aircraft, to improve combat effectiveness.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2404 Aeromechanics and Integration

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	Complete measurements of the actual aero-optics effects encountered when employing a laser weapon on a fighter aircraft.			
(U)				
(U)	MAJOR THRUST: Develop and assess technologies for the next generation of multi-role large aircraft.	2.445	3.557	6.101
(U)	In FY 2005: Continued efforts to develop and assess aeronautical technologies to enable revolutionary tanker and transport aircraft designs for rapid global mobility, including multi-role designs. Continued to develop technologies to enable multiple roles and missions for delivery and support aircraft.			
(U)	In FY 2006: Continue to develop and assess aeronautical technologies including high lift systems, transonic, and structural designs that enable revolutionary tanker and transport aircraft designs for rapid global mobility. Continue to develop technologies that enable multiple roles and missions for delivery and support aircraft.			
(U)	In FY 2007: Further development and assessment of aeronautical technologies including high lift systems, transonic, and structural that enable revolutionary tanker and transport aircraft designs for rapid global mobility. Continue to develop technologies that enable multiple roles and missions for delivery and support aircraft.			
(U)				
(U)	CONGRESSIONAL ADD: Unique Stealth Unmanned Air Vehicle Houck Aircraft Design Program.	1.180	1.380	0.000
(U)	In FY 2005: Initiated Congressionally-directed effort for unique stealth unmanned air vehicle Houck aircraft design program.			
(U)	In FY 2006: Continue Congressionally-directed effort for unique stealth unmanned air vehicle Houck aircraft design program.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Wright Brothers Institute (WBI) - Characterization of Airborne Environment for Tactical Lasers.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Initiate Congressionally-directed effort for Wright Brothers Institute (WBI) - characterization of airborne environment for tactical lasers.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	28.100	28.852	29.618

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602201F Aerospace Vehicle Technologies**	PROJECT NUMBER AND TITLE **2404 Aeromechanics and Integration**

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0603211F, Aerospace Technology Dev/Demo.

(U) PE 0604015F, Next Generation Bomber.

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

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0602202F
PE TITLE: Human Effectiveness Applied Research

Exhibit R-2, RDT&E Budget Item Justification

DATE: **February 2006**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602202F Human Effectiveness Applied Research**

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	83.867	108.171	92.991	80.574	84.135	84.810	84.899	Continuing	TBD
1123	Warfighter Training	12.927	17.566	15.322	13.594	14.329	14.450	14.526	Continuing	TBD
1710	Deployment and Sustainment	9.979	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
7184	Decision Effectiveness & Biosciences	36.854	65.078	56.625	49.135	51.616	52.117	52.227	Continuing	TBD
7757	Bioeffects and Protection	24.107	25.527	21.044	17.845	18.190	18.243	18.146	Continuing	TBD

Note: In FY 2006, Deployment and Sustainment efforts will move from Project 1710 to Project 7184. Funds for the FY 2006 Congressionally-directed Carbon Nanostructured Material for Fluid Purification in the amount of $5.0 million are in the process of being moved to PE 0602202F, Human Effectiveness Applied Research, from PE 0602102F, Materials, for execution.

(U) A. Mission Description and Budget Item Justification

This program establishes technical feasibility and develops technology for protecting and enhancing human effectiveness for Air Force weapon systems and for operational readiness. The program addresses warfighter training, deployment and sustainment of forces, warfighter system interface, biodynamic response, directed energy bioeffects, crew performance and protection, and counterproliferation. The Warfighter Training project focuses on the development and evaluation of new methods and technologies to enhance Air Force training and education. The Deployment and Sustainment project develops and evaluates technologies that will increase supportability of the force and weapon systems. The Decision Effectiveness and Biosciences project develops and evaluates technologies that will improve human performance and combat effectiveness. The Bioeffects and Protection project develops technologies to predict and mitigate the biological effects of aerospace stressors, directed energy, and other threats on personnel and mission performance. Note: In FY 2006, Congress added $1.0 million for Genetics of Sleep Deprivation and Fatigue, $1.0 million for Flexible Display and Integrated Communication Device for the Battlefield Air Operations (BAO), $1.0 million for Eyewear Display for Battlefield Operations, $1.3 million for Nanoparticles Directed by DNA Capture Elements for the Detection and Neutralization of Bioterrorist Agents, $2.5 million for Improved Performance Research Integration Tool (IMPRINT), $1.0 million for Bio Medical DNA Program, $1.4 million for Network Warfighter Decision Support, $1.4 million for Special Operations Target Acquisition and Control Suite (SO-TACS), $1.0 million for Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) Fusion System, $1.0 million for Bacterial Ghost Vaccine for Influenza Virus, $2.2 million for Component Object Model Attitude Control System Simulation/Trainer, $2.5 million for Fused Carbon Nanotube Material for Fluid Purification, $4.8 million for Solid Electrolyte Oxygen Separator, $4.4 million for Warfighter Pocket XP Project, $2.8 million for Warfighter Sustainability: Maximizing Human Performance, and $1.0 million for Rapid ID and Treatment for Air Force Medical Service. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	85.128	79.442	87.812
(U)	Current PBR/President's Budget	83.867	108.171	92.991
(U)	Total Adjustments	-1.261	28.729	
(U)	Congressional Program Reductions		-0.007	
	Congressional Rescissions	-0.066	-1.564	
	Congressional Increases		30.300	
	Reprogrammings			
	SBIR/STTR Transfer	-1.195		

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602202F Human Effectiveness Applied Research**

PROJECT NUMBER AND TITLE: **1123 Warfighter Training**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
1123 Warfighter Training	12.927	17.566	15.322	13.594	14.329	14.450	14.526	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project identifies and analyzes new methods and technologies to improve Air Force training and education. The research focuses on aircrew training; technical training; mission rehearsal; training in support of complex decision-making; information warfare training; and warfighter readiness training. It investigates the spectrum of new and advanced training and education technologies to design and implement training, and to evaluate training effectiveness. It combines fundamental knowledge from the cognitive and neural sciences with information technology to create desktop tutors, courseware development tools and technologies, assessment methodologies, and simulation technologies to achieve maximum learning effectiveness for specific needs at minimum cost. These technologies and methods will increase operational readiness by providing more effective methods and approaches to train and assess personnel. This project contributes to a more highly trained and flexible cadre of personnel at a reduced cost.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Research perceptual issues involving the development of new visual technologies to enhance Distributed Mission Operations (DMO) environments. Research identifies the visual requirements necessary for realistic aircrew training and mission rehearsal, allowing Air Force warfighters to train as they intend to fight.	1.688	1.575	2.353

(U) In FY 2005: Developed and applied techniques and devices to evaluate projector displays and visual system components. Evaluated existing and proposed Helmet-Mounted Displays (HMD) and deployable display technologies for use in visual simulation and training. Identified specifications of the functional requirements for deployable displays and HMDs for training and recommended features required beyond those in commercially available devices.

(U) In FY 2006: Research and analyze human factor and perceptual issues for off-boresight targeting simulation in DMO multifaceted simulator displays. Evaluate and research techniques for cockpit, helmet-mounted, and out-the-window visual simulation systems for air-to-ground and composite force training. Identify, research, and resolve head-mounted and deployable display issues for next generation deployable visual simulation systems. Conduct engineering and human factors analyses of display devices.

(U) In FY 2007: Research and specify key perceptual performance parameters for deployable visual display systems including resolution, image stability, target tracking accuracy, and transport delay. Assist in the development of head-mounted and deployable display proof-of-concepts that meet these specifications. Continue research and evaluation of visual system requirements for air-to-ground and composite force training. Conduct engineering and human factors analyses of display devices.

(U)

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **1123 Warfighter Training**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST: Research and analyze tools, strategies, and performance support methods for improving combat mission training, rehearsal, and operations for aircrews and command and control forces. Research provides the combat air forces and global strike operations with the empirical data and guidelines for improving learning in training and for enhancing the quality, management, and effectiveness of all aspects of distributed mission training and distributed mission operations and live operations training, rehearsal and exercise environments through the identification and application of competency-based training methods.	8.113	8.463	9.588
(U)	In FY 2005: Completed guidelines for applying Distributed Mission Training (DMT) to the Air Combat Command Ready Aircrew Program training and mission objectives based on identified competencies. Completed specification of mission essential competencies for operators in Air Operations Center (AOC) specialty teams and unique positions. Developed competency-based behavioral models and representations of select operators for use in simulation-based training systems. Completed development of specification tools for coalition training and collaborative mission planning.			
(U)	In FY 2006: Evaluate integrated learning and readiness assessment models, data, and specifications. Assess usability of exemplar DMO training scenario design tool. Explore and evaluate virtual environment training syllabi capable of tailoring to individual needs. Investigate fully immersive training environments, with realistic, interactive visual scenery that can be adapted by multiple platforms. Analyze how spin-up time after brief and extended delays can be reduced with virtual reality training.			
(U)	In FY 2007: Evaluate capability to assess learning and proficiency within live, virtual, and constructive operational contexts. Identify metrics and develop preliminary guidelines for initial, refresher, and continuation training and rehearsal. Identify common competency requirements and evaluate instructional designs for common training requirements across operational mission areas. Begin development of fully immersive, just-in-time training environments, with realistic, interactive content and training strategies, that can be adapted for use within and across missions. Develop a learning management-based migration plan for integrating full fidelity training and rehearsal systems with more generalizable software-driven training, rehearsal, and exercise environments.			
(U)				
(U)	MAJOR THRUST: Explore performance improvement techniques to enhance aerospace operational training in realistic mission training environments. Research provides enabling technologies for improving readiness across an assortment of Air Force career fields, from air combat forces to command and control personnel.	1.662	1.910	3.381
(U)	In FY 2005: Enhanced air and space operations through the investigation of training principles, guidelines, and criteria for use in synthetic training environments. Explored application of cognitive science principles for use in preparing and sustaining aerospace expeditionary forces.			
(U)	In FY 2006: Create a communication model through cognitive science principles and techniques to improve the			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 1123 Warfighter Training

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	training of AOC airmen. Establish computational techniques to predict how the distribution of training opportunities influences the acquisition and long-term retention of complex skills by verifying and validating predictive skill acquisition and decay models with DMO data.			
(U)	In FY 2007: Integrate the communication model into a proof-of-concept synthetic communication agent for AOC training. Verify and validate the knowledge and skill tracking prediction system and integrate with mission essential competencies to predict training requirements for airmen and demonstrate ability to produce individualized training programs. Test predictive validity of cognitive moderator models.			
(U)				
(U)	CONGRESSIONAL ADD: Improved Performance Research Integration Tool (IMPRINT).	1.464	2.464	0.000
(U)	In FY 2005: Designed and implemented an enhancement to IMPRINT that could create the capability to estimate the impact of how initial training, subsequent non-use, and recovery of knowledge and skills affect performance in a system/mission context.			
(U)	In FY 2006: Conduct Congressionally-directed effort for IMPRINT.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Component Object Model Attitude Control System Simulation/Trainer.	0.000	2.168	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Component Object Model Attitude Control System Simulation/Trainer.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: C4ISR Fusion System.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for C4ISR Fusion System.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	12.927	17.566	15.322

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602233N, Human Systems									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **1123 Warfighter Training**

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

Technology.

(U) PE 0602716A, Human Factors Engineering Technology.

(U) PE 0602785A, Personnel Performance and Training Technologies.

(U) PE 0603231F, Crew Systems and Personnel Protection Technology.

(U) PE 0604227F, Distributed Mission Training (DMT).

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602202F Human Effectiveness Applied Research**

PROJECT NUMBER AND TITLE: **1710 Deployment and Sustainment**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
1710 Deployment and Sustainment	9.979	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, Deployment and Sustainment efforts will move from Project 1710 to Project 7184.

(U) A. Mission Description and Budget Item Justification

This project develops technologies to support the enhancement of the deployment and sustainment capabilities critical to Agile Combat Support and Air Expeditionary Force (AEF) operations. The research focuses on technologies that have the potential to reduce the time required for units to plan, pack up, and deploy, and to reduce airlift requirements, while enhancing deployed capabilities. It investigates and evaluates technologies to enhance the sustainment of deployed forces in contingency operations and to improve logistics support for both combat and peacetime operations. It develops toxicological tools and technology to minimize the risks and mission impact to DoD personnel from exposure to hazardous chemicals, while also reducing weapon systems life cycle cost.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop logistics sustainment technology options and perform feasibility studies to support large-scale advanced technology development programs. These technologies will lead to more supportable weapon systems at reduced logistics support costs.	2.076	0.000	0.000
(U) In FY 2005: Conducted research to establish the science base for simulation of cognitive behavior. Developed algorithms and interface requirements for logistics reachback in support of contingency operations. Developed software components to accurately model mixed initiative (human and synthetic actor) decision-making support.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop logistics readiness technology options and perform feasibility studies to support large-scale advanced technology development programs. These technologies will lead to more efficient utilization of logistics resources for AEF operations.	1.598	0.000	0.000
(U) In FY 2005: Examined new techniques to identify both functional and system requirements, as well as new information presentation techniques for future logistics and maintenance software tools. Continued working to define the requirements and component technologies necessary to support a more automated and responsive maintenance environment. Designed foundational models for advanced simulation capabilities that optimize limited logistics resources during operations. Defined "sense-respond" capabilities which will promote effects-based logistics through a common operating picture.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 1710 Deployment and Sustainment

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	MAJOR THRUST: Develop, demonstrate, and apply predictive assessment models to determine the toxicological risks to airmen if exposed to operational compounds and materials. This will improve commanders' decision-making ability to properly balance mission and force protection requirements.	0.884	0.000	0.000
(U)	In FY 2005: Developed biotechnology procedures and computer simulation models to predict effects of toxic exposure on airmen and improve the protection of Air Force personnel. Developed and demonstrated algorithms to describe the function of a cell-like entity with the potential for improved logic, sensor, and bio-electromechanical capability for Air Force systems.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop nuclear magnetic resonance (NMR) technologies that will identify warfighter exposure to toxic chemicals before they result in illness or a reduction in mission performance, thus greatly improving force protection and the probability of mission success.	4.445	0.000	0.000
(U)	In FY 2005: Conducted genomic and NMR studies and initiated proteomic and metabolite studies to identify target-organ biomarkers in body fluids of the deployed warfighter exposed to hazardous agents. Assessed target-organ response biomarker patterns for early detection of the effects of unknown hazardous agents on Air Force personnel.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Bio Medical DNA Program.	0.976	0.000	0.000
(U)	In FY 2005: Conducted Congressionally-directed effort for Bio Medical DNA Program.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	9.979	0.000	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602233N, Human Systems									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **1710 Deployment and Sustainment**

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

Technology.

(U) PE 0602716A, Human Factors Engineering Technology.

(U) PE 0603231F, Crew Systems and Personnel Protection Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602202F Human Effectiveness Applied Research**

PROJECT NUMBER AND TITLE: **7184 Decision Effectiveness & Biosciences**

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
7184	Decision Effectiveness & Biosciences	36.854	65.078	56.625	49.135	51.616	52.117	52.227	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, Deployment and Sustainment efforts will move from Project 1710 to Project 7184. Funds for the FY 2006 Congressionally-directed Carbon Nanostructured Material for Fluid Purification in the amount of $5.0 million are in the process of being moved to PE 0602202F, Human Effectiveness Applied Research, from PE 0602102F, Materials, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops the technology required to enhance deployment capabilities, human performance, biodynamic response, and survivability in all operational environments. By investigating the technologies to enhance deployment capabilities this program seeks to improve logistical support for peacetime and combat operations. This research further defines the physical and cognitive parameters, capabilities, and limits of systems operators; determining human responses to operational stresses such as noise, impact, vibration, maneuvering acceleration, spatial disorientation, workload and optimizing the human-machine interface. It produces human-centered design criteria, guidelines, and design tools for developing effective human-system interfaces. It develops and assesses technologies for information display, human-centered information operations, team communications, modeling and simulation, and human-centered Intelligence, Surveillance, and Reconnaissance operations. It conducts experiments and evaluations of control interfaces, crew station layout and functional integration, human information processing, crash protection, and emergency escape technologies. It also develops biotechnologies and tools to minimize the risks and mission impact to DoD personnel from exposure to hazardous chemicals, while also reducing weapon systems life cycle cost.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop interface technologies that enhance human-human and human-machine collaboration in network-centric warfare environments. These technologies will enable the common operational understanding and shared, distributed decision making required on the modern battlefield.	4.704	4.959	5.452

(U) In FY 2005: Demonstrated the feasibility of a situational awareness estimator to improve real-time task sharing during multi-platform unmanned combat air vehicle missions. Explored the decision support benefits of multi-sensory controls and displays for intelligent autonomous air vehicles and for multi-mission command and control aircraft, and demonstrate a common functionality for ground control centers and for airborne control platforms. Performed laboratory simulations to determine strike chain efficiencies achievable from network-centric interfaces that span airborne controllers, unmanned vehicles, and special forces on the ground. Researched speech signal processing and speech-based countermeasures for information operations and demonstrated a multimedia speech extraction interface.

(U) In FY 2006: Begin spiral development of a laboratory prototype of a speech recognizer/synthesizer based on multilingual phoneme acoustic models designed to enhance collaboration between multinational forces. Complete development of human-machine interface style guide and begin development of a collaboration toolkit, both essential

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7184 Decision Effectiveness & Biosciences

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	for developing effective warfighter interfaces for air battle management command and control (BMC2). Complete development of an operator cognitive state assessment package that enables real-time human-machine collaboration.			
(U)	In FY 2007: Determine the risk and benefit of adding language, accent, and domain models into the laboratory speech recognizer/synthesizer, and continue to develop advanced speech processing technology. Complete development of a collaboration toolkit for BMC2. Develop and evaluate BMC2 decision support technologies, and plan to demonstrate operational benefits in an advanced technology program. Demonstrate the ability of the cognitive state assessment package to evaluate real-time human-machine collaboration during simulated BMC2 missions.			
(U)				
(U)	MAJOR THRUST: Develop cognitive system interface technologies to achieve common understanding at all echelons of operations and to improve decision-making and predictive battlespace awareness. These technologies offer breakthrough potential for understanding and modeling human behavior, in order to assure timely and effective decisions, while also providing context-sensitive human-computer interfaces that support decision effectiveness.	2.432	3.520	3.962
(U)	In FY 2005: Transitioned to advanced development a cognitive interface and knowledge repository to support decision making in the future AOC. Continued a multi-year exploration of information, display, and course-of-action aids by demonstrating a multi-mode information interface to speed air tasking orders.			
(U)	In FY 2006: Identify and develop software design patterns that enable the standardization and reuse of human-computer interface elements in Command and Control Intelligence, Surveillance, and Reconnaissance systems. Begin to develop collaboration techniques that enable diverse users to share a common object representation of the problem domain. Perform laboratory research on the cultural and ethnic bases of human decision-making. Develop methods to represent knowledge about adversaries as a key technology in overcoming barriers that limit effects-based operations.			
(U)	In FY 2007: Continue development and begin the transition to advanced development of software design patterns that enable the standardization of human-computer interface elements in Command and Control Intelligence, Surveillance, and Reconnaissance systems. Continue to develop collaboration techniques and methods to embed them in command and control systems. Continue researching the cultural and ethnic bases of human decision making and begin to develop human performance models that reflect these differences to enable effects-based operations.			
(U)				
(U)	MAJOR THRUST: Establish the technology base for a decision support environment that enables the Joint Forces Commander (JFC), Joint Force Air Component Commander (JFACC), and command staffs to interrelate the past, present, and future battlefield mission states and to predict the intent and actions of adversaries during Joint	0.000	4.250	3.750

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7184 Decision Effectiveness & Biosciences

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Operations. Note: In FY 2006, this increase in funding is due to greater emphasis on commanders decision aids.			
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop advanced visualization techniques that enable the uncertainty associated with information to be incorporated into the iconic or graphic portrayal scheme for command center display. Begin to develop methods to simulate enemy potential courses of action. Begin the development of "sensemaking" tools for dynamic battlefields. Begin research toward developing knowledge representation techniques to model potential adversaries and complex systems of systems. Begin research to develop an integrated set of work aids that will support a commander's decision-making in a future environment of continuous Anticipatory Planning and Operations (APO).			
(U)	In FY 2007: Continue developing advanced visualization techniques that enable the uncertainty associated with information to be incorporated into the iconic or graphic portrayal scheme for command center display. Continue to develop, and begin to transition to advanced development, needed methods to simulate enemy potential courses of action, beginning with simple models of adversary behavior. Conduct laboratory experiments to evaluate "sensemaking" tools and displays for dynamic battlefields. Continue to develop knowledge representation techniques to model potential adversaries and complex systems of systems. Continue to develop an integrated set of APO work aids to achieve persistent operational planning, persistent prediction, and focused execution even as military and broad national security objectives are dynamically changing.			
(U)				
(U)	MAJOR THRUST: Develop system control interface concepts enabling full operator exploitation of all platform capabilities. Identify the best mix of intelligent methods and traditional design to unambiguously direct the operator's attention, which is critical for net-centric operations. Employ real-time and wargaming simulations to quantify operational benefits from new information portrayal concepts.	3.478	4.591	5.443
(U)	In FY 2005: Researched requirements and applications for system control technologies that will enable human supervision and control of distributed teams of semi-autonomous vehicles. Explored a control-display concept that reduces task load and channelized attention for unmanned combat air vehicles, and evaluated its use for secondary missions of air refueling and electronic attack. Explored the practicality of human behavior models to reliably evaluate displays, began to develop fusion algorithms that combine on-board and off-board sensor data with imagery, and simulated the ability of a single operator to perform multiple tasks of target nomination.			
(U)	In FY 2006: Using virtual simulation, evaluate decision support interface concepts to enable single operator supervision of multiple semi-autonomous unmanned systems. For unmanned combat air vehicles, evaluate first generation control-display concepts that reduce operator task load and mitigate channelized attention. Continue to develop fusion algorithms that combine on-board and off-board sensor data with imagery. Begin to explore the integration of computer-generated pictures with sensor images to enable autonomous approach and landing.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7184 Decision Effectiveness & Biosciences

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Demonstrate real-time assessment tools and advanced decision support interfaces, including prediction capability, for maximizing single operator supervision of multiple highly autonomous unmanned aerial vehicles within net-centric environments. Begin design and development of second generation control-display concepts that reduce operator task load and mitigate channelized attention. Begin algorithm development to blend display imagery with computer-generated graphical representations of terrain and real-time data to conduct autonomous landing and ground operations at night and during adverse weather.			
(U)				
(U)	MAJOR THRUST: Develop visual display interface technologies, specifically Helmet-Mounted Displays (HMDs), night vision technologies, and large flat-panel displays. Develop an understanding of the effects of vision through display optics, vehicle transparencies, and synthetic vision. Task optimized visualization and vision enhancement using these technologies enable higher information consumption rates day and night across mission applications.	4.733	5.209	4.786
(U)	In FY 2005: Determined ways to reduce the negative effects of binocular disparity, lasers, and distortion through helmet visors. Developed HMD target acquisition and location symbology to reduce decision uncertainty during targeting. Evaluated design options that permit HMDs to replace legacy head-up displays in aircraft and explore HMD benefits in remote presence applications. Assessed visual performance measures suitable for predicting display requirements under realistic viewing conditions. Developed algorithms to enhance vision electronically when using head-mounted solid state imagers.			
(U)	In FY 2006: Continue development of algorithms to electronically enhance vision when using head-mounted solid state imagers. Evaluate those algorithms using realistic simulations of warfighter visual tasks. Begin development of methods to depict command and control and other complex types of information in intuitive, easy to understand ways.			
(U)	In FY 2007: Continue to evaluate and improve algorithms to electronically enhance vision when using head-mounted solid state imagers. Continue development of methods to depict command and control and other complex types of information in intuitive, easy to understand ways. Evaluate the methods using realistic simulations of the targeted combat environments.			
(U)				
(U)	MAJOR THRUST: Develop advanced audio display technologies for human-to-human collaboration including three-dimensional audio, active noise reduction, and related technologies that mitigate effects of noise and enhance performance and information processing in the operational environment. In particular, these battlespace acoustic interfaces will integrate with warfighter equipment and amplify information throughout.	2.746	3.987	4.371
(U)	In FY 2005: Completed technology assessment of acoustic remote threat detection in perimeter defense, and explored the use of acoustic detection capabilities by special tactics forces. Demonstrated the feasibility of			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7184 Decision Effectiveness & Biosciences

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	combining active noise reduction with three-dimensional (3-D) audio communications for a high performance (50 dB) hearing protection system. Identified a concept to validate the dynamic noise model in terms of lowering the cost of collecting acoustic data, and explored acoustic modeling for operational analysis. Analyzed how to minimize acoustic detection of vectored thrust aircraft. Developed virtual audio interface technology using dynamic audio/visual interaction for use with HMDs.			
(U)	In FY 2006: Begin to research acoustic signal control to improve human-to-human communications through noise reduction systems and improved acoustic signal processing. Continue to explore the value of acoustic modeling for operational analysis. Continue to analyze how to minimize acoustic detection of vectored thrust aircraft. Begin to develop auditory information aiding technologies for improving collaboration in operational command and control environments. Explore how the novel use of ultrasonic auditory projection can enhance command and control operations.			
(U)	In FY 2007: Continue to research acoustic signal control to improve human-to-human communications in operational environments by improving noise reduction technologies and use of acoustic signal processing to improve information gathering for security forces. Begin to research methods to incorporate weather effects on noise propagation and ways to represent weather effects in dynamic noise models. Continue to develop auditory information aiding technologies for remote collaboration. Explore how to improve audio symbology for streamlining command and control operations including 3-D audio symbology. Begin to explore the human processes that lead to communication breakdown.			
(U)				
(U)	MAJOR THRUST: Develop integrated human-centered Information Operations (IO) and Intelligence, Surveillance, and Reconnaissance (ISR) technologies to provide quicker and more intuitive access to information, enhanced decision-making capabilities, more effective training procedures, and improved tools for IO/ISR operators' use in performing their respective missions. Note: In FY 2006 and out, this increase in funding is due to greater emphasis on IO and ISR technologies.	5.650	9.067	11.421
(U)	In FY 2005: Conducted research to develop IO and ISR natural collaboration links, training, cultural modeling, and predictive battlespace awareness capabilities. Developed proof-of concept technologies to specify, measure, and model key parameters.			
(U)	In FY 2006: Conduct research to develop better visualization for spectral data exploitation and to improve predictive battlespace awareness capabilities. Continue next stage of developing proof-of-concept technologies to specify, measure, and model key parameters.			
(U)	In FY 2007: Conduct research and implementation of models for IO and ISR. Develop conceptual human system interfaces for additional Measurement and Signatures Intelligence capabilities, specifically in the spectral area.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7184 Decision Effectiveness & Biosciences

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Develop tools and models for assessing the effectiveness of influence operations. Complete development of proof-of-concept technologies to specify, measure, and model key parameters.			
(U)				
(U)	MAJOR THRUST: Develop human injury criteria and protective system technologies to provide sanctuary from injury and disability causing threats to military personnel. Research will develop technologies to ensure accommodation and safety of all airmen during military operations, such as flight, ground patrols, crashes, emergency escape, extended missions, and parachute opening shock.	4.204	5.552	5.744
(U)	In FY 2005: Investigated and evaluated technologies to ensure full aircrew population safety during aircraft and vehicle operations including vibration, crashes, emergency escape, extended mission, and parachute opening shock. Revised injury criteria to account for variations in biodynamic response based on individual crewmember differences in size and gender. Investigated seating systems to improve crewmember comfort while maintaining safety during emergency escape or other mishap. Developed helmet weight and center of mass limits for symmetric and asymmetric HMD systems to ensure safety during emergency escape.			
(U)	In FY 2006: Using available safety and medical databases, evaluate and begin addressing primary Air Force injury and physical health effects causes. Define criteria functions to relate seat cushion comfort to measurable parameters for use in seating requirements. Develop initial collaborative information system for analyzing environmental threats and developing immunity strategies. Begin determining the effects and interrelationships between equipment fit, workload, marginal anthropometry, and physical capability.			
(U)	In FY 2007: Develop injury criterion for multi-axial dynamic neck loading and standards for gender and demographics. Determine the effects and interrelationships between equipment fit, workload, marginal anthropometry, physical capability, cognitive capability, and increased equipment loads on pilot crew performance. Using risk-based analysis, identify primary musculoskeletal disability causes and begin addressing equipment, procedure, or training improvements. Develop initial data mining and analysis tools for searching across biomechanics, safety, and medical information systems.			
(U)				
(U)	MAJOR THRUST: Quantify and model the effects of aerospace stressors on pilot performance, cognitive function, and safety in dynamic flight environments. Develop design criteria and technologies to ensure effectiveness and safety of helmet-mounted systems and other protective equipment during maneuvering acceleration.	2.826	1.625	1.544
(U)	In FY 2005: Developed protective technologies and helmet-mounted systems design criteria for the full aircrew population based on crew performance in operational maneuvering environments. Refined models for human information processing in the dynamic environment and initiated incorporation into wargaming and simulation-based acquisition.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7184 Decision Effectiveness & Biosciences

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Investigate asymmetric helmet loads in high-G environment and assess effects on helmet aiming and pointing. Continue cognitive model incorporation into wargaming scenarios and simulation-based acquisition.			
(U)	In FY 2007: Develop concepts to reduce effects of heavy flight helmets in the high-G environment. Complete validation and transition of high-G cognitive model for simulation-based acquisition. Explore multisensory technologies for augmented cognition to enhance performance in dynamic environments.			
(U)				
(U)	MAJOR THRUST: Develop technologies to counter Spatial Disorientation (SD) and improve pilot performance, resulting in increased mission effectiveness and decreased loss of lives and aircraft due to SD mishaps. Note: This effort completes in FY 2005.	2.566	0.000	0.000
(U)	In FY 2005: Completed flight-testing of Pathway-in-the-sky utilizing a HMD to complete the transition from Head-Up Display to HMD. Developed a syllabus for SD countermeasure training for the Integrated Panoramic Night Vision Goggles and specific recommendations for the optimum mix of visual, audio, and tactile cueing to avoid spatial disorientation.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop, demonstrate, and apply experimental models for predictive assessment to create in-house and fielded methods to determine the toxicological risks to airmen exposed to operational compounds and materials. Improve commanders' decision-making ability to properly balance mission and force protection requirements. Note: In FY 2006, this effort moved from Project 1710.	0.000	0.881	1.601
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop procedures and computer simulation models to predict effects of toxic compound and nanomaterial exposure on Air Expeditionary Forces and improve the protection of Air Force personnel in operational environments. Continue development and demonstration of algorithms to describe the function of a cell-like entity with the potential for improved logic, sensor, and bioelectromechanical capability for Air Force systems.			
(U)	In FY 2007: Apply procedures and computer simulation models to predict effects of toxic compound and nanomaterial exposure on Air Expeditionary Forces and improve the protection of Air Force personnel in operational environments. Further develop and demonstrate algorithms to describe the function of a cell-like entity with the potential for improved logic, sensor, and bioelectromechanical capability for Air Force systems.			
(U)				
(U)	MAJOR THRUST: Develop biotechnologies to identify warfighter exposures to hazardous agents before they result in illness or a reduction in mission performance, thus greatly improving force protection and the probability of	0.000	4.974	6.339

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7184 Decision Effectiveness & Biosciences

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
mission success. Note: In FY 2006, this effort moved from Project 1710.			
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Conduct genomic, proteomic, and metabolite studies to identify target-organ biomarkers in body fluids of the deployed airmen exposed to hazardous agents. Assess kidney and liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on Air Force personnel.			
(U) In FY 2007: Continue to conduct genomic, proteomic and metabolite studies to identify target-organ biomarkers in body fluids of the deployed airmen exposed to hazardous agents. Complete kidney and assess liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on Air Force personnel.			
(U)			
(U) MAJOR THRUST: Develop logistics readiness technology options and perform feasibility studies to support large-scale advanced technology development programs. These technologies will lead to more efficient utilization of logistics resources for Air Expeditionary Force operations. Note: In FY 2006, this effort moved from Project 1710.	0.000	1.972	2.212
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Complete examination of new techniques to identify both functional and system requirements. Continue to investigate and apply new information presentation techniques for future logistics and maintenance software tools. Continue work on defining "sense-respond" capabilities which will promote effects-based logistics through a common operating picture. Begin to develop methods of quantifying levels of success of logistics and maintenance operations in support of flying missions.			
(U) In FY 2007: Continue to investigate and apply new techniques for future logistics and maintenance technical data presentation and training. Continue work on defining sense-respond capabilities which will promote effects-based logistics using a net-centric environment. Identify technology gaps to meet previously defined emergency response logistics requirements.			
(U)			
(U) CONGRESSIONAL ADD: Special Operations Target Acquisition and Control Suite (SO-TACS).	1.367	1.380	0.000
(U) In FY 2005: Developed knowledge management tools to improve mission planning for special tactics operators. Explored enhanced methods for target identification using synthetic overlays and virtual comparisons in day and night settings. Assessed the value of onboard hyperlinked reference files to improve operator performance. Devised an improved moving map display for better situational awareness. Evaluated predicted battle effects to improve battle damage and threat assessment.			
(U) In FY 2006: Conduct Congressionally-directed effort for SO-TACS.			
(U) In FY 2007: Not Applicable.			
(U)			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7184 Decision Effectiveness & Biosciences

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	CONGRESSIONAL ADD: Network Warfighter Decision Support.	1.074	1.380	0.000
(U)	In FY 2005: Developed algorithms and control/display technologies that enhance the Unmanned Aerial Vehicle (UAV) operator's anticipatory decision making to include generating multiple courses of action, predicting target location, and identifying the likely adversary reactions. Developed robust and intuitive methods for the UAV crew to rapidly sort and evaluate multiple courses of action. Integrated and evaluated UAV console concepts in virtual simulation, culminating with full mission simulation using the most appropriate Air Force facilities.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Network Warfighter Decision Support.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: AFSOC Battlefield Air Operations Kit.	1.074	0.000	0.000
(U)	In FY 2005: Conducted Congressionally-directed effort for AFSOC Battlefield Air Operations Kit.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Bio Medical DNA Program. Note: In FY 2005, this effort was executed in Project 1710.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Bio Medical DNA Program.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Bacterial Ghost Vaccine for Influenza Virus.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Bacterial Ghost Vaccine for Influenza Virus.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Eyewear Display for Battlefield Operations.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Eyewear Display for Battlefield Operations.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Flexible Display and Integrated Communication Device for the BAO.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7184 Decision Effectiveness & Biosciences

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Conduct Congressionally-directed effort for Flexible Display and Integrated Communication Device for the BAO.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Fused Carbon Nanotube Material for Fluid Purification.	0.000	2.464	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Fused Carbon Nanotube Material for Fluid Purification.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Rapid ID and Treatment for Air Force Medical Service.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Rapid ID and Treatment for Air Force Medical Service.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Warfighter Pocket XP Project.	0.000	4.337	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Warfighter Pocket XP Project.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	36.854	65.078	56.625

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602201F, Aerospace Flight Dynamics.									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0602702F, Command, Control, and Communications.									
(U) PE 0603205F, Flight Vehicle Technology.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **7184 Decision Effectiveness & Biosciences**

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

(U) PE 0603231F, Crew Systems and Personnel Protection Technology.

(U) PE 0603245F, Flight Vehicle Technology Integration.

(U) PE 0604706F, Life Support Systems.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE: 7757 Bioeffects and Protection	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
7757 Bioeffects and Protection	24.107	25.527	21.044	17.845	18.190	18.243	18.146	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project predicts and mitigates the effects of exposure to directed energy, warfighter fatigue, altitude, and high, rapid-onset gravitational forces. The project enables the safe operational use of Air Force aerospace systems through technology developments that ameliorate/counter/exploit the biological effects of aerospace stressors, directed energy, and other threats. It addresses areas such as safety, risk assessment, mission planning, countermeasures, personnel protection, and counterproliferation research, technology development, and validation. The project also assesses the bioeffects of directed energy technologies for force protection, special operations, military operations other than war, and peacekeeping applications.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Conduct laboratory experiments and field research on laser bioeffects, enabling military exploitation of laser technology while providing countermeasures for optical hazards/threats.	5.937	5.578	6.804
(U) In FY 2005: Developed technologies to evaluate human vision impacts of multi-wavelength lasers. Developed technologies to objectively determine the components of combat vision when laser eye protection, along with other technologies, are used in an integrated concept. Investigated the safety and effectiveness of emerging compact, ultrashort pulse laser technologies for directed energy weapons applications. Explored new methods of conducting threshold damage studies to reduce reliance on in vivo experimentation. Developed bioeffects-based safety criteria for test, deployment, and use of high-energy laser systems.			
(U) In FY 2006: Continue developing technologies to evaluate human vision impacts of multi-wavelength lasers. Continue developing technologies to improve combat vision, including laser eye protection, in an integrated concept. Complete bioeffects studies and advocate revisions to national and international safety standards in the near infrared based on laboratory data and validated models. Explore the use of biotechnology as an adjunct to human protection from certain laser exposures.			
(U) In FY 2007: Continue developing technologies to improve combat vision and provide laser eye protection in an integrated concept. Continue developing technologies to evaluate human vision impacts of multi-wavelength lasers. Develop robust modeling and simulation programs and first approximations of near real-time probabilistic risk assessment tools. Further develop the use and application of biotechnology to evaluate human health in response to high power lasers.			
(U)			
(U) MAJOR THRUST: Conduct electromagnetic (EM) field bioeffects laboratory experiments and field research to enable the safe exploitation of directed energy technologies for communication, target identification, and weapons	4.112	5.207	6.597

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7757 Bioeffects and Protection

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
development while identifying countermeasures to EM hazards/threats.			
(U) In FY 2005: Enhanced and applied laboratory and field assessment techniques and models for efficient evaluation of human health and performance impact of exposure to high peak power and ultra-wideband microwaves being developed for anti-electronic and advanced radar applications. Used bioassessment techniques to reveal possible low-level and non-thermal effects of radio frequency radiation. Integrated energy-deposition model with energy-distribution model for advanced dosimetry tools to assess human hazards to microwave exposure. Conducted research to support scientifically-based effectiveness, hazard, and safety criteria for EM fields, including millimeter waves, in military applications.			
(U) In FY 2006: Develop methods to evaluate the bioeffects of directed energy weapons. Extend laboratory and field assessment techniques into the terahertz range. Develop modeling and simulation tools to evaluate the human health, behavior, and performance impact of high frequency EM systems. Evaluate human health in response to high power and high peak power EM systems using biotechnology. Continue to conduct research to support scientifically-based human exposure standards.			
(U) In FY 2007: Further refine methods to evaluate the bioeffects of directed energy weapons. Continue to extend laboratory and field assessment techniques into the terahertz range. Continue to enhance modeling and simulation tools to evaluate the human health, behavior, and performance impact of high frequency EM systems. Continue to evaluate human health in response to high power and high peak power EM systems using biotechnology. Continue to conduct research to support scientifically-based human exposure standards.			
(U)			
(U) MAJOR THRUST: Develop biotechnologies to accurately and affordably support the assessment of threat agents. Perform counterproliferation research to enable air operations to continue in the most efficient manner.	2.882	3.268	5.651
(U) In FY 2005: Conducted feasibility studies investigating biological counterproliferation. Designed and developed innovative counterproliferation technologies.			
(U) In FY 2006: Develop technologies to identify the production source of threat agents. Develop methods to assess the viability and activity of threat agents and continue counterproliferation research to predict and minimize collateral damage.			
(U) In FY 2007: Continue to develop technologies to identify the production source of threat agents. Continue to develop and validate methods to assess the viability and activity of threat agents after active countermeasures have been employed. Refine counterproliferation research to better predict and further minimize collateral damage.			
(U)			
(U) MAJOR THRUST: Develop technologies to alleviate the detrimental effects of operational stressors on human performance. Results will extend and enhance vigilance, cognitive and physical performance, and survivability in	2.341	1.330	1.630

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7757 Bioeffects and Protection

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
continuous (24/7) mission environments.			
(U) In FY 2005: Developed counter-fatigue strategies to sustain human performance during extended missions and continuous operations. Expanded development of model-based quantitative fatigue management capabilities to include tactics, techniques, and procedures to reduce fatigue-induced errors in vigilance-demanding command and control and information operations tasks.			
(U) In FY 2006: Refine and test fatigue model to expand performance predictions for additional air and space applications. Identify and assess novel fatigue countermeasures and associated delivery mechanisms to improve human performance in specific operational aerospace environments. Develop and demonstrate modeling of fatigue interventions.			
(U) In FY 2007: Investigate individual differences in human performance variability and response to performance enhancing interventions. Identify and validate methods for real-time performance assessment. Develop methodology to incorporate individual differences in human performance vulnerability and response to performance enhancing interventions into an operational performance optimization capability.			
(U)			
(U) MAJOR THRUST: Develop technologies and procedures to counter physiological effect of high altitude flight, improve pilot performance under high, rapid-onset gravitational forces, and deliver oxygen. Research will enhance airman safety during global attack, global mobility, and special operations missions.	0.729	0.386	0.362
(U) In FY 2005: Completed investigation of effects of break in oxygen prebreathe time on altitude decompression sickness risk. Explored emerging technologies and alternative G-protection concepts for their potential to improve performance, comfort, and operator acceptability of life support equipment. Assessed chemical contaminant penetration in aircrew breathing gases produced by onboard oxygen generation system (OBOGS) technologies. Conducted quick-turn scientific consultations to resolve aircrew protection issues in ongoing flight operations such as altitude and acceleration protection.			
(U) In FY 2006: Evaluate advanced materials and innovative design concepts to reduce bulk and thermal burden of aircrew protective equipment. Quantify performance characteristics of oxygen systems technologies for multiple special operations scenarios.			
(U) In FY 2007: Evaluate ability of candidate integrated aircrew ensemble technology components to address identified life support equipment deficiencies. Continue assessment of oxygen generation systems technology effectiveness in a chemical environment.			
(U)			
(U) CONGRESSIONAL ADD: Solid Electrolyte Oxygen Separator (SEOS).	6.738	4.731	0.000
(U) In FY 2005: Developed, characterized, and modeled planar, multi-cell, solid electrolyte membrane stacks to validate			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7757 Bioeffects and Protection

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	oxygen separator performance. Developed, miniaturized, and analyzed advanced SEOS breadboard devices designed for potential Air Force applications. Developed and evaluated next generation solid electrolyte stack designs to obtain radical improvements in SEOS performance.			
(U)	In FY 2006: Conduct Congressionally-directed effort for SEOS.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Laser Bioeffects.	1.368	0.000	0.000
(U)	In FY 2005: Developed integrated technology concepts that enhance visual performance and enable application of non-lethal force during force protection operations. Further refined protection against laser injuries from unconventional weapons.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Genetics of Sleep Deprivation and Fatigue.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Genetics of Sleep Deprivation and Fatigue.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Nanoparticles Directed by DNA Capture Elements for the Detection and Neutralization of Bioterrorist Agents.	0.000	1.281	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Nanoparticles Directed by DNA Capture Elements for the Detection and Neutralization of Bioterrorist Agents.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Warfighter Sustainability: Maximizing Human Performance.	0.000	2.760	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Warfighter Sustainability: Maximizing Human Performance.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	24.107	25.527	21.044

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7757 Bioeffects and Protection

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602720A, Environmental Quality Technology.

(U) PE 0603231F, Crew Systems and Personnel Protection Technology.

(U) PE 0604617F, Agile Combat Support.

(U) PE 0604706F, Life Support Systems.

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

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0602203F
PE TITLE: Aerospace Propulsion

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	129.190	155.673	170.885	159.359	167.671	170.348	172.094	Continuing	TBD
3012	Advanced Propulsion Technology	12.140	19.593	25.038	22.601	23.046	23.430	23.795	Continuing	TBD
3048	Fuels and Lubrication	15.577	18.997	17.292	13.029	13.797	13.957	14.079	Continuing	TBD
3066	Turbine Engine Technology	33.769	36.862	33.529	34.433	36.593	37.083	37.517	Continuing	TBD
3145	Aerospace Power Technology	42.993	44.392	30.364	31.667	33.782	34.309	34.804	Continuing	TBD
33SP	Space Rocket Component Tech	0.000	0.000	49.305	46.497	48.774	49.726	49.925	0.000	0.000
4847	Rocket Propulsion Technology	24.711	35.829	15.357	11.132	11.679	11.843	11.974	Continuing	TBD

Note: In FY 2007, Project 33SP, Space Rocket Component Technology will transfer from PE 0602500F, Multi-Disciplinary Space Technology, Project 5026, Rocket Propulsion Component Technology, and Project 5027, High Speed Airbreathing Propulsion Technology, in order to more effectively manage and provide oversight of the efforts. Funds for the FY2006 Congressionally-directed Notre Dame Center for Flow Physics and Control in the amount of $3.0 million are in the process of being moved to PE 0601102F, Defense Research Sciences, from PE 0602203F, Aerospace Propulsion, for execution. Funds for the FY2006 Congressionally-directed Lightweight Photovoltaic Electricity and Hydrogen for Portable, On-Demand Power for Defense Applications in the amount of $1.0 million are in the process of being moved to PE 0602601F, Space Technology, from PE 0602203F, Aerospace Propulsion, for execution.

(U) A. Mission Description and Budget Item Justification

This 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. The Advanced Propulsion Technology develops high-speed airbreathing propulsion engines to include combined cycle, ramjet, and hypersonic scramjet technologies to enable revolutionary propulsion capability for the Air Force. The Fuels and Lubrication project develops new fuels, lubricants, and combustion concepts and technologies for new and existing engines and directly supports the Integrated High Performance Turbine Engine Technology (IHPTET) and the Versatile Affordable Advanced Turbine Engine (VAATE) programs. The Turbine Engine Technology project develops enabling capabilities to enhance performance and affordability of existing weapon systems to include efforts that are part of the IHPTET and VAATE programs. The Aerospace Power project develops efficient energy conversion/storage, power generation/power conditioning/distribution, and thermal management techniques for ground, air, and space military applications. Finally, the Rocket Propulsion Technology project pursues advances in rocket technologies for space access, space maneuver, and tactical and strategic missiles to include efforts that are part of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) and Technology for the Sustainment Systems (TSSS) programs. Note: In FY 2006, Congress added $4.3 million for Advanced Vehicle and Propulsion Center (AVPC), $1.0 million for Aerospace Lab Equipment Upgrade, $1.8 million for Affordable Lightweight Power Supply Development, $1.0 million for Cell-Level Battery Control, $1.4 million for Center for Security of Large-Scale Systems, $1.3 million for High Flux ESC System with TES for Military High Energy Laser, $1.0 million for High Regression Rate Hybrid Rocket Fuels, $1.0 million for Information Assurance Initiative, $5.3 million for Integrated Power and Aircraft Technologies (INPACT), $0.5 million for Intelligent Engine Software Development for Advanced Turbine Engines, $18.0 million for Jet and Rocket Engine Test Set (JRETS), $1.0 million for Lightweight Photovoltaic Electricity and Hydrogen for Portable, On -Demand Power for Defense Applications, $1.4 million for MEPS Thermal Management, $3.0 million for Notre Dame Center for Flow Physics and Control, $1.7 million for Portable Power Solution Employing Chemical Hydrides, $2.5 million for Pulse Detonation Engine,

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BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion

$1.4 million for Ultrafast, Ultraintense Laser Micro Fabrication and Diagnostics, $1.8 million for VAATE (Versatile Affordable Advanced Turbine Engine) - TMC Flade Technology Demonstration, and $1.0 million for Wavelength Agile Spectral Harmonic Sensor. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	132.918	107.523	115.360
(U)	Current PBR/President's Budget	129.190	155.673	170.885
(U)	Total Adjustments	-3.728	48.150	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.101	-2.250	
	Congressional Increases		50.400	
	Reprogrammings	-1.498		
	SBIR/STTR Transfer	-2.129		

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT NUMBER AND TITLE: 3012 Advanced Propulsion Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3012 Advanced Propulsion Technology	12.140	19.593	25.038	22.601	23.046	23.430	23.795	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2005, funding level was reduced as Air Force efforts shifted from variable-geometry demonstrators to Advanced Technology Development (6.3) fixed-geometry demonstrators. In FY 2006 and 2007, funding was increased to accelerate efforts to develop technologies to support an Air Force scramjet effort.

(U) A. Mission Description and Budget Item Justification

This project develops combined/advanced cycle airbreathing high-speed (up to Mach 4) and hypersonic (Mach 4 to 8+) propulsion technologies to provide revolutionary propulsion options for the Air Force. These new engine technologies will enable future high-speed/hypersonic weapons and aircraft 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 NASA. Efforts include modeling, simulations, and proof of concept demonstrations of critical components; advanced component development; and ground-based demonstrations.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop advanced fuel-cooled scramjet engine technologies to support flight demonstration and enable the broad application of hypersonics to meet future warfighter needs.	6.804	7.702	12.204

(U) In FY 2005: Demonstrated flight-weight control valves in full-scale combustion tests. Demonstrated engine control inputs and preliminary control algorithms based on sensing shock location and stability. Performed detailed analysis mating of scramjet flight engines to demonstrator vehicles. Furthered the trajectory optimization for flight test. Completed evaluation of gas generator as engine start technique. Performed initial evaluation of barbotage fuel injection as scramjet starting aid. Performed initial verification of engine control techniques, based on rapid shock train identification/characterization coupled with fuel control logic, to ensure stable scramjet operation. Completed fabrication of a flight weight, fuel-cooled ground test engine with a variable geometry inlet.

(U) In FY 2006: Continue development and demonstration of flight weight engine components and a control system with closed loop controller. Continue performing trajectory optimization for flight test. Continue evaluating options for scramjet start, including gas generator/heat exchanger system, barbotage fuel injection, plasma ignition, and silane injection with a mechanical throat or air throttle. Continue verification of operation of engine control techniques, based on rapid shock train identification/ characterization coupled with fuel control logic, to ensure stable scramjet operation. Design, fabricate, and initiate ground test of a flight weight, fixed geometry inlet scramjet engine with improved operability to reduce flight test risk.

(U) In FY 2007: Continue development and demonstration of flight weight engine components and a control system with closed loop controller. Continue performing trajectory optimization for flight test. Continue evaluating options for scramjet start, including gas generator/heat exchanger system, barbotage fuel injection, plasma ignition, and

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	silane injection with a mechanical throat or air throttle. Continue verification of operation of engine control techniques, based on rapid shock train identification/ characterization coupled with fuel control logic, to ensure stable scramjet operation. Complete ground test of a flight weight, fixed geometry inlet scramjet engine with improved operability to reduce flight test risk.			
(U)				
(U)	MAJOR THRUST: Conduct assessments, system design trades, and simulations to integrate combined cycle engines (CCEs) and advanced cycle airbreathing hypersonic propulsion technologies into future missiles and into manned and unmanned air and space vehicle concepts. CCEs require the development and demonstration of components to integrate scramjets with high speed turbines and/or rocket engines for efficient propulsion over a broad range of Mach numbers.	0.234	1.079	2.239
(U)	In FY 2005: Performed system trade studies to determine military payoff and establish component technology goals. Established initial component and engine performance objectives to enable development of affordable hypersonic flight demonstrators including potential efforts jointly with NASA and DARPA.			
(U)	In FY 2006: Continue system trade studies to determine military payoff and establish component technology goals. Continue defining component and engine performance objectives to enable development of affordable hypersonic flight demonstrators jointly with NASA and DARPA. Initiate development of advanced components for turbine-based and rocket-based CCEs. Initial emphasis is on advanced inlets for turbine-based CCEs capable of operating for Mach 0-8. Design sub-scale inlet test article.			
(U)	In FY 2007: Continue system trade studies to determine military payoff and establish component technology goals. Continue defining component and engine performance objectives to enable development of affordable hypersonic flight demonstrators jointly with NASA and DARPA. Continue development of advanced components for turbine-based and rocket-based CCEs. Fabricate and initiate test of advanced inlets for turbine-based CCEs capable of operating for Mach 0-Mach 8.			
(U)				
(U)	MAJOR THRUST: Develop robust hydrocarbon fueled scramjet engine components and technologies to improve performance, operability, durability, and scalability for future missiles and for aerospace vehicles.	4.128	9.826	10.595
(U)	In FY 2005: Assessed scaling and structural efficiency for rectangular, circular, and elliptical scramjets for the development of advanced engine components to improve scramjet operating margin and to establish scramjet scaling laws for reusable applications. Conducted analysis of advanced inlets and isolators while developing techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Supported development of low internal drag flame stabilization devices and flight test engine components.			
(U)	In FY 2006: Continue development of advanced engine components to improve scramjet operating margin and to			

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BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3012 Advanced Propulsion Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	establish scramjet scaling laws for reusable applications. Continue development of variable geometry techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Fabricate and initiate test of scramjet combustors sized for reusable applications with improved structural efficiency. Support development of low internal drag flame stabilization devices and flight test engine components.			
(U)	In FY 2007: Continue development of advanced engine components to improve scramjet operating margin and to establish scramjet scaling laws for reusable applications. Continue development of variable geometry techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Complete test of scramjet combustors sized for reusable applications with improved structural efficiency. Initiate development of improved durability engine concepts. Continue development of low internal drag flame stabilization devices and flight test engine components.			
(U)				
(U)	CONGRESSIONAL ADD: Information Assurance Initiative.	0.974	0.986	0.000
(U)	In FY 2005: Provide enhanced security and emergency response to physical threats/attacks and natural disasters.			
(U)	In FY 2006: Support technology infrastructure security with upgrades in electronic security of doors, security of video teleconferencing systems and for a central public address systems and separate research and development network.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	12.140	19.593	25.038

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0601102F, Defense Research Sciences.									
(U) PE 0602201F, Aerospace Flight Dynamics.									
(U) PE 0602500F, Multi-Disciplinary Space Tech.									
(U) PE 0602602F, Conventional Munitions.									
(U) PE 0602702E, Tactical									

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BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602203F Aerospace Propulsion**	PROJECT NUMBER AND TITLE **3012 Advanced Propulsion Technology**

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

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.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT NUMBER AND TITLE: 3048 Fuels and Lubrication

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3048 Fuels and Lubrication	15.577	18.997	17.292	13.029	13.797	13.957	14.079	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops improved fuels, lubricants, mechanical systems, and combustion concepts for advanced turbine engines, scramjets, pulse detonation, and combined cycle engines, and technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. Systems applications include missiles, aircraft, sustained high-speed vehicles, and responsive space launch. Analytical and experimental areas of emphasis include fuels and fuels logistics, lubricants, bearings, electromagnetic rotor, oil-less engine technology, optical diagnostics, fundamental combustion, and detonations. Fuels and lubricants for these engines must be thermally stable, cost-effective, and operate over a broad range of conditions. Advanced combustion concepts must be cost-effective, durable, and reduce pollutant emissions.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop low-cost additive and fuel system approaches to improve fuel properties and to expand the flight envelope for manned and unmanned aircraft.	1.540	1.780	2.172
(U) In FY 2005: Completed additive package optimization and test protocols to enable JP-8 to achieve the performance of JPTS (jet propellant thermally stable). Conducted lab-scale evaluation of approaches to increase JP-8 temperature capability to 900 degrees Fahrenheit, including thermal stability additives, fuel deoxygenation, and improved materials and coatings. Further enhanced existing fuel modeling and simulation capabilities by incorporating more realistic additive performance models. Developed engine thermal management models.			
(U) In FY 2006: Continue conducting lab-scale evaluation of approaches to increase JP-8 temperature capability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced alternative energy fuels, and improved materials and coatings. Complete initial development of engine thermal management models, aiming toward system-level models of advanced aircraft. Initiate development of laboratory-scale combustion tests for evaluating combustion performance of fuels and additives at low fuel and air temperatures.			
(U) In FY 2007: Continue conducting lab-scale evaluation of approaches to increase JP-8 temperature capability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced alternative energy fuels, and improved materials and coatings. Initiate effort to validate component performance models on aircraft thermal management simulator. Continue to develop approaches to assess and improve additive combustion behavior at low fuel and air temperatures. Test fuel candidates in bench scale rigs simulating advanced high Mach propulsion systems.			
(U)			
(U) MAJOR THRUST: Develop advanced additive approaches to reduce engine emissions and signature (including nano-scale additives), as well as advanced emission diagnostic test protocols.	0.955	1.103	1.347

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BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3048 Fuels and Lubrication

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2005: Completed development and application of advanced diagnostics for sub-micron particulate emissions for the assessing additives performance in laboratory scale combustion tests.			
(U)	In FY 2006: Continue assessing novel fuel additives including nano-technologies and fuels derived from alternative energy resources to reduce emissions in laboratory scale combustion rigs. Develop higher-pressure laboratory-scale combustion tests and diagnostics for sub-micron particulate investigations.			
(U)	In FY 2007: Complete assessing novel fuel additives including nano-technologies and fuels derived from alternative energy resources to reduce emissions in laboratory scale combustion rigs. Initiate higher-pressure measurements of additive and fuel effects on sub-micron particulate generation during combustion.			
(U)				
(U)	MAJOR THRUST: Study and evaluate low-cost approaches to reduce fuel logistics footprint to simplify logistics and reduce cost (including field and on-board additive injections and improvements to existing fuel additive packages), as well as study fuel logistics vulnerabilities and develop detection and mitigation technologies.	0.955	1.103	1.347
(U)	In FY 2005: Developed improvements to existing fuel additive packages to simplify logistics and reduce cost. Completed extensive thermal stability, low temperature viscosity, and emissions testing of one Fischer-Tropsch (F-T) fuel and initiated testing of F-T/JP-8 fuel blends. Further investigated biological contamination in fuels and the impact of fuel logistic supply chains. Performed initial development of field mitigation techniques for biological fuel contamination. Demonstrated use of DNA sequencing and Polymerase Chain Reaction (PCR) to identify many organisms in field jet fuel samples not found using current techniques in the development of new field fuel quality diagnostics for fuel properties and bio-contamination.			
(U)	In FY 2006: Complete assessment of fuel additives optimization for logistics footprint reduction. Continue to investigate performance of F-T and other alternative fuels for aircraft and other field hardware. Complete investigation of supply chain biological contamination and the impact on fuel logistics. Initiate evaluation of nano-technology fuel sensors and biological mitigation techniques. Complete development of advanced field diagnostics techniques for fuel properties and bio-contamination.			
(U)	In FY 2007: Continue to investigate performance of F-T and other alternative fuels for aircraft and other field hardware. Continue evaluation of advanced nano-technology fuel sensors, nano-technology fuel additives, and novel detection and mitigation technologies for biological growth.			
(U)				
(U)	MAJOR THRUST: Investigate hydrocarbon and other high energy density fuels for advanced and combined cycle engines for high-speed aerospace vehicles and low-cost boost applications.	0.477	0.552	0.673
(U)	In FY 2005: Developed fuel property and performance database for industry and Government use in selecting alternative hydrocarbon fuels for boost applications. Tested approaches to assess fuel thermal stability under high			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3048 Fuels and Lubrication

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	heat flux conditions relevant to advanced rockets and combined cycle engines.			
(U)	In FY 2006: Continue to assess advanced hydrocarbon propellant stability under high heat flux conditions for advanced rockets and combined cycle engines.			
(U)	In FY 2007: Continue to assess advanced hydrocarbon propellant stability under high heat flux conditions. Collect improved fuel property data for hydrocarbon propellant database.			
(U)				
(U)	MAJOR THRUST: Develop, test, and evaluate revolutionary combustor and propulsion concepts for gas turbine, pulsed detonation, and combined cycle engines for missiles, manned and unmanned systems, and reuseable access to space; perform payoff analyses and configuration trade studies for these systems; and evaluate the combustion and emissions characteristics of fuels and fuel additives.	3.328	3.845	4.691
(U)	In FY 2005: Evaluated compact, high performance combustion systems at realistic operating conditions. Investigated larger-scale, inter-turbine burner combustor concepts at realistic operating conditions. Evaluated combined cycle pulsed detonation engine (PDE) concepts. Addressed the operational issues associated with incorporating PDE propulsion technologies into gas turbine engines. Conducted experiments to extend the operability limits of pure PDE for application to high-speed missiles. Evaluated fundamental combustion issues associated with combustors fed by high-temperature fuel systems like those required for supersonic cruise aircraft.			
(U)	In FY 2006: Begin evaluating advanced combustion system performance at realistic operating conditions. Start investigating larger-scale inter-turbine burner concepts at relevant engine operating conditions to increase mission flexibility. Continue developing a PDE into turbine-based hybrid concept. Conduct experiments to validate chemical kinetics of practical fuels at high pressure and temperature. Perform modeling and simulation of advanced combustion systems to decrease design cycle time, optimize compact combustor, and augmentor designs, and to understand physical parameters controlling combustion processes. Evaluate and develop novel lightweight, high performance augmentor concepts.			
(U)	In FY 2007: Continue evaluating advanced combustion system performance at realistic operating conditions. Continue investigating inter-turbine burning concepts for large gas turbine engines. Continue integration of PDE into turbine-based hybrid concept. Evaluate and optimize advanced combustor, augmentor, and PDE concepts using modeling and simulation tools.			
(U)				
(U)	MAJOR THRUST: Develop approaches to extend the life of endothermic fuels and fuel system components for sustained supersonic and reusable hypersonic cruise applications.	0.477	0.552	0.676
(U)	In FY 2005: Evaluated, at a laboratory scale, approaches to improve fuel heat sink capability. Tested systems to minimize regenerative cooling heat loads absorbed by endothermic fuel systems. Tested means to improve fuel			

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	combustion performance, especially during cold start and cycle transition. Demonstrated combustion and heat sink performance of alternatives to baseline JP-7 fuel to improve fuel system modeling and simulation tools to better simulate endothermic fuel behavior.			
(U)	In FY 2006: Continue evaluating, at a laboratory scale, approaches to improve fuel heat sink and provide thermal management capability for high speed systems. Evaluate surface/catalyst effects on coke reduction to improve fuel heat sink capability and increase fuel system life. Initiate assessment of unconventional approaches to increase fuel heat sink, such as steam reforming.			
(U)	In FY 2007: Continue development of improved surfaces/catalysts to mitigate coking and thus improve fuel heat sink capability. Continue assessment of unconventional approaches to increase fuel heat sink and minimize regenerative cooling heat loads, including low heat rejection structures.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for application to revolutionary propulsion technologies.	0.600	0.692	0.845
(U)	In FY 2005: Completed developing and testing sensors for the control of combustor performance and extension of component life. Developed diagnostic tools to evaluate the combustion issues related to engines burning high-temperature fuels. Performed initial investigation of the interaction of high-intensity laser light with matter for micromachining and diagnostic capabilities.			
(U)	In FY 2006: Begin applying advanced laser diagnostics for accurate measurements inside advanced gas turbine combustion systems that will improve design cycle time. Develop sensor technologies for use in intelligent gas turbine engine combustion systems for enhanced operability, increased durability and performance. Continue investigation of high intensity laser light with matter for micromachining and diagnostic capabilities.			
(U)	In FY 2007: Continue application of advanced diagnostics in a relevant gas turbine combustion system environment. Apply diagnostics to sensor development and validate sensors in relevant gas turbine engine system. Conduct experiments to obtain benchmark-quality data for improvement of combustion modeling and simulation tools.			
(U)				
(U)	MAJOR THRUST: Develop, test, and qualify advanced turbine engine lubricants for the Air Force and DoD. Establish target requirements and transition opportunities for new oils by working with DoD agencies, industry, and users. Generate and maintain military specifications for aviation engine lubricants, as well as continued field support activities for aviation lubrication technologies and DoD operational units.	1.853	2.140	2.612
(U)	In FY 2005: Expanded development and testing of advanced bearing and lubrication system concepts, components, and materials for improved engine performance, affordability, and engine health monitoring. Designed test approaches for optimal ester lubricant to military and commercial turbine engines. Coordinated oil research and			

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	development activities between Government, engine manufacturers, and oil companies in support of the Joint Oil Program (JOP). Engaged oil companies to deliver prototype lubricants and initiated bench top evaluation. Designed test approaches for JOP lubricants for use in new fighter demonstration engines.			
(U)	In FY 2006: Continue development and testing of advanced bearing and lubrication system concepts, components, and materials for improved engine performance, affordability, and engine health monitoring. Continue testing to focus and develop lubricants and mechanical systems for man-rated, expendable, and Unmanned Aerial Vehicle (UAV) turbine engines. Design test approaches for enhanced high thermal stability (HTS) oils for new, legacy, and commercial turbine engines. Focus optimal ester lubricant development on high Mach/high temperature military and commercial turbine engines. Test prototype JOP lubricants with mechanical hardware in preparation of new fighter demonstration engines.			
(U)	In FY 2007: Begin technology insertion of advanced bearing and lubrication system concepts, components, and materials for improved engine performance, affordability, and engine health monitoring into demonstrator cores and engines. Continue testing to focus and develop lubricants and mechanical systems for man-rated, expendable, and UAV turbine engines. Continue optimal ester lubricant development for high Mach/high temperature military and commercial turbine engines. Coordinate and support demonstration of JOP lubricants in new fighter asset engines. Deliver military specifications and test methods for DoD lubricants to support new fighter engines.			
(U)				
(U)	MAJOR THRUST: Develop and test advanced bearing material technology and bearing concepts for small, intermediate, and large-sized turbine engine applications.	2.077	2.400	2.929
(U)	In FY 2005: Conducted fatigue life screening tests of advanced bearing materials on 40mm size bearings in support of large turbofan engines. Modified an existing test rig to investigate foil bearing load capacity and rotor dynamic stiffness and damping coefficients under dynamic load conditions for a high Mach engine application, specifically ultra-high temperature lubrication concepts and composite bearing cages for supersonic missile engines and bearing heat generation studies for large engines. Conducted modeling and simulation activities to advance design, shorten development time, and reduce test requirements for mechanical and electromagnetic rotor support and power generation systems. Supported industry development of hybrid (metal/ceramic) bearing designs for new fighter engines.			
(U)	In FY 2006: Continue conducting airfoil shaft bearing testing in large shaft diameter sizes to determine load capacity and rotor size limitations of this technology. Continue development and test of affordable rotor support technology for small-, intermediate-, and large-sized turbine engine applications. Continue enhancement of modeling and simulation activities to advance design, shorten development time, and reduce test requirements for mechanical and electromagnetic rotor support and power generation systems. Continue modeling airfoil shaft bearings for advanced			

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	engine rotor support and power generation. Begin full-scale tests of hybrid (metal/ceramic) bearing technology for the new fighter demonstrator engines with lubricant from the JOP. Initiate study of mechanical systems thermal management concepts for turbo accelerators in combined cycle engines.			
(U)	In FY 2007: Continue conducting airfoil shaft bearing tests in larger shaft diameter sizes to determine load capacity and rotor size limitations of this technology. Continue development and test of affordable rotor support technology for small-, intermediate-, and large-sized turbine engine applications. Continue enhancement of modeling and simulation activities to advance design, shorten development time, and reduce test requirements for mechanical and electromagnetic rotor support and power generation systems. Improve the modeling of airfoil shaft bearings and initiate evaluation of insertion opportunities for advanced engine rotor support and power generation. Continue transition/transfer of airfoil shaft bearing technology to bearing and engine companies. Demonstrate hybrid (metal/ceramic) bearing and JOP lubricants in the new fighter demonstrator engines. Initiate programs for hardware needed for optimum thermal protection designs for high mach/high temperature turbine engines and accelerators. Expand the previous studies of advanced rotor support and power generation for turbine and combined cycle engines.			
(U)				
(U)	CONGRESSIONAL ADD: Intense, Ultrafast Laser Microfabrication and Diagnostics.	0.975	1.380	0.000
(U)	In FY 2005: Developed the technology base required to reduce the development, production, and maintenance costs of advanced weapon systems through the use of intense, ultrafast lasers.			
(U)	In FY 2006: Develop technology to exploit characteristics of intense, ultrafast lasers for sensors and weapons systems. Investigate these systems for use in gas turbine engine diagnostics. Develop a new generation of extreme light diagnostics that can be used to: analyze and evaluate materials, aid in the development and validation of system design and life prediction models, and perform inspections for fleet maintenance.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Wavelength Agile Spectral Harmonic Oxygen Sensor.	0.975	0.986	0.000
(U)	In FY 2005: Developed a sensor using wavelength agile spectral harmonics to measure oxygen concentration in high-performance fuel tanks, allowing the verification and optimization of nitrogen inerting.			
(U)	In FY 2006: Design, fabricate, and test a second generation oxygen sensor to measure oxygen concentration in high-performance fuel tanks. Conduct environmental testing of the sensor under simulated fuel tank conditions and perform Category A flight testing to aid in modification of the design, resulting in a third generation sensor design. Also conduct an evaluation of second generation sensor specifications and certification plan.			
(U)	In FY 2007: Not Applicable.			
(U)				

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(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	CONGRESSIONAL ADD: Hybrid Bearings.	1.365	0.000	0.000
(U)	In FY 2005: Accelerated the development of advanced hybrid bearing technology, which will provide increased thrust load and speed capability, reliability, and a safety margin of aircraft turbine engines.			
(U)	In FY 2006: Develop advanced hybrid bearing technology for use in high performance turbine engines. Conduct bearing fatigue life testing of advanced Pyrowear 675 (P675) hybrid bearings, P675 heat treatment optimization and characterization, develop critical flaw models for Silicon Nitride (Si3N4) bearing balls, and experimentally validate models. Also investigate advanced Nondestructive Evaluation (NDE) methods for Si3N4 bearing balls and conduct full-scale bearing performance testing of advanced hybrid bearings.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Pulse Detonation Engine (and Laser Induced Thermal Acoustics Instrument).	0.000	2.464	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Assess and validate pulsed detonation propulsion technology from inlet-to-nozzle through free or semi-free jet testing. Enhance capability to demonstrate detonation initiation techniques in an integrated test rig. Conduct test firings with multiple detonation initiation methods in parallel to provide technology risk reduction and alleviate detonation initiation difficulties.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	15.577	18.997	17.292

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 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									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3048 Fuels and Lubrication

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

eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE: 3066 Turbine Engine Technology	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3066 Turbine Engine Technology	33.769	36.862	33.529	34.433	36.593	37.083	37.517	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the Fiscal Year 2006 Congressionally-directed Notre Dame Center for Flow Physics and Control in the amount of $3.0 million are in the process of being moved to PE 0601102F, Defense Research Sciences, from PE 0602203F, Aerospace Propulsion, for execution.

(U) A. Mission Description and Budget Item Justification

This 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, augmentor and exhaust systems, integrated power and thermal management systems, engine inlet integration, mechanical systems, and structural design. This project supports the Integrated High Performance Turbine Engine Technology (IHPTET) and Versatile Affordable Advanced Turbine Engine (VAATE) programs, which are joint DoD, NASA, and industry efforts to focus turbine propulsion technology on national needs. The program plan reflects the technology base support for VAATE activity applicable to global responsive strike, capable unmanned warfighting, tactical and global mobility, responsive space lift, and persistent Intelligence, Surveillance, and Reconnaissance.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop core turbofan/turbojet engine components (i.e., compressors, combustors, and high-pressure turbines) for fighters, bombers, sustained supersonic/hypersonic cruise vehicles, and transports. Note: In FY 2006, efforts will further develop advanced concepts, designs, design rules, and computational tools to increase efficiency and operability, decrease weight, and improve durability of axial compressors, combustors, and high pressure turbines (HPT), as well as improve pattern factor and decrease harmful emissions of combustors, and increase HPT cooling effectiveness. These efforts enable aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.	16.361	16.728	17.727

(U) In FY 2005: Rig tested a high-pressure ratio compressor including an assessment of unsteady flow interactions for reduced fuel burn, and high reaction blading and engine stall avoidance techniques for reduced maintenance cost. Concluded full annular aerothermal tests of a trapped vortex combustor. Rig tested an integrated lightweight combustor with a ceramic matrix composite shell and advanced material panels representative of advanced combustor configurations. Completed fabrication and test advanced high-pressure turbine rig hardware to evaluate advanced three-dimensional effects on blade tip heat transfer for increased performance and durability. Enhanced advanced intentional mistuning methodology and completed experimental verification on transonic rig hardware.

(U) In FY 2006: Develop and apply advanced modeling and simulation rules and tools for advanced components (high cycle fatigue, computational fluid dynamics, cycle analyses, propulsion system models, component life models, probabilistic models, etc.). Incorporate advanced materials systems into innovative designs (gamma titanium aluminides, metal matrix composites, ceramics, new metallic alloys, etc.). Develop and extend analytical methods to

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	predict integrally bladed rotor and airfoil durability, and damage tolerance. Conduct bench and rig tests of advanced components for validation, such as an advanced metal foam heat exchanger.			
(U)	In FY 2007: Continue to develop and apply advanced modeling and simulation rules and tools for advanced components. Incorporate advanced materials systems into innovative designs and analyze Ceramic Matrix Composite turbine blades, turbine vanes, and turbine rear frame. Design and analyze tiled turbine airfoil technology to reduce cooling flow and increase life. Design and demonstrate a very short, high efficiency afterburner concept. Conduct rig tests and design optimization of effective, durable, radiation barrier coatings to reduce the radiant heat loads on hot section components. Design, fabricate, and rig test fan/radial compressor internal aerodynamics, large radius rotating air seals, a low profile annular combustor, and a large scale casting of fan/radial compressor.			
(U)				
(U)	MAJOR THRUST: Develop turbofan/turbojet engine components (i.e., fans, low pressure turbines, engine controls, exhaust nozzles, and integration technologies) for turbofan/turbojet engines for fighters, bombers, sustained supersonic strike and hypersonic cruise vehicles, and transports. Note: In FY 2006, funding increases to support new focus to further develop advanced concepts, designs, design rules, and computational tools to increase efficiency and operability, decrease weight, and improve durability of fans, low pressure turbines (LPT), control systems, augmentors, and exhaust nozzles, as well as increase LPT cooling effectiveness, increase control systems parameters and response, and reduce augmentors observability and screech. These efforts enable aircraft engines to have higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.	10.244	10.475	11.100
(U)	In FY 2005: Performed post-test analysis of multi-stage low-pressure rig test data to assess performance of advanced turbine blade configurations applicable to high altitude, long endurance systems. Concluded testing advanced control system hardware using component life models to verify real-time computational capabilities for transitioning this technology to a demonstrator engine program. Concluded analysis and tests of advanced, low-observable compatible augmentor designs, resulting in improved design rules and tools to improve augmentor operability and reduce screech.			
(U)	In FY 2006: Develop and apply advanced modeling and simulation rules and tools for advanced components (high cycle fatigue, computational fluid dynamics, cycle analyses, propulsion system models, component life models, probabilistic models, etc.). Apply advanced materials systems to innovative designs (gamma titanium aluminides, metal matrix composites, ceramics, advanced metallic alloys, etc.). Develop new and innovative design concepts, and conduct bench and rig tests of advanced components for validation.			
(U)	In FY 2007: Identify and quantify sources of variability and uncertainty affecting turbine blade durability performance (oxidation, creep, thermal material fatigue, high cycle fatigue, etc.). Apply advanced materials systems to innovative designs to determine wear reduction, improve load capacity, and increase temperature capability of five			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	centi-stokes oil and to assess aerodynamics, operability, aeromechanics, and acoustic characteristics of a counter-rotating fan-on-blade (FLADE) concept. Conduct design optimization for turbine blade microcircuit cooling. Test pilot and fuel injection concepts in a single-flameholder rig to evaluate fundamental capabilities.			
(U)				
(U)	MAJOR THRUST: Develop limited life engine components for missile and unmanned air vehicle applications, including long-range supersonic and hypersonic vehicles. These efforts enable engines with reduced cost, reduced fuel consumption, and increased specific thrust, thereby greatly expanding the operating envelopes of missiles and unmanned vehicles.	3.257	3.330	3.530
(U)	In FY 2005: Completed configuration studies and developed conceptual design of an advanced versatile and affordable high-pressure core and low-pressure component configurations for expendable engines using rub tolerant ceramic blades to meet the small engine performance and cost reduction objectives.			
(U)	In FY 2006: Complete conceptual design of an advanced versatile and affordable high-pressure core and low-pressure component configurations for expendable engines using rub tolerant ceramic blades to meet the small engine performance and cost reduction objectives. Apply advanced materials systems to innovative designs and analyze a slinger-fed, dual-fuel compact recirculation combustor (CRC). Develop and apply advanced modeling and simulation rules and tools for advanced components (i.e., high cycle fatigue (HCF), computational fluid dynamics (CFD), cycle analyses, propulsion system models, component life models, probabilistic models, etc.). Complete detailed design, computational fluid dynamics, and perform analyses for a fuel-cooled turbine. Develop new and innovative design concepts, and conduct bench and rig tests of advanced components for validation.			
(U)	In FY 2007: Rig test a slinger-fed, dual-fuel CRC. Continue to develop and apply advanced modeling and simulation rules and tools for advanced components (i.e., high cycle fatigue, computational fluid dynamics, cycle analyses, propulsion system models, component life models, probabilistic models, etc.). Rig test a fuel-cooled turbine. Design and analyze a five-stage forward swept compressor.			
(U)				
(U)	MAJOR THRUST: Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.	1.081	1.105	1.172
(U)	In FY 2005: Enhanced conceptual design of advanced versatile and affordable high-pressure core engine component configurations for turboshaft/turboprop engines to meet the small engine performance and cost reduction objectives			
(U)	In FY 2006: Develop and apply advanced modeling and simulation rules and tools for advanced components (i.e., HCF, CFD, cycle analyses, propulsion system models, component life models, probabilistic models, etc.). Complete conceptual design of advanced versatile and affordable high-pressure core engine component configurations for turboshaft/turboprop engines to meet the small engine performance and cost reduction objectives. Apply advanced			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	materials systems to design and analyze a high heat release combustor. Develop new and innovative design concepts and conduct bench and rig tests of advanced components for validation.			
(U)	In FY 2007: Continue to develop and apply advanced modeling and simulation rules and tools for advanced components. Apply advanced materials systems to innovative designs and analyze a nano-laminate thermal barrier coating. Develop new and innovative design concepts and conduct bench and rig tests of advanced components for validation such as a high heat release combustor.			
(U)				
(U)	CONGRESSIONAL ADD: VAATE-Titanium Matrix Composites.	0.974	1.774	0.000
(U)	In FY 2005: Applied Titanium Matrix Composite materials to an advanced fan design with the goal of increasing performance and/or reducing weight.			
(U)	In FY 2006: Utilize previous Titanium Matrix Composite (TMC) modeling predictions to design and build test scale hardware and initiate response and fatigue testing.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Center for Flow Physics and Control.	1.852	2.957	0.000
(U)	In FY 2005: Conducted experimental and analytical studies to determine optimal diagnostic configuration for new high-speed sensors and actuators to evaluate gaseous flow through a turbine engine. Used results to design more accurate and effective laboratory test facility for engine design.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Notre Dame Center for Flow Physics and Control.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Intelligent Engine Software Development for Advanced Turbine Engines.	0.000	0.493	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Apply advanced intelligent software design methodologies to develop a Universal FADEC that would be applicable to all commercial and military gas turbine engines.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	33.769	36.862	33.529

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Materials:									
(U) PE 0601102F, Defense Research									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology

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

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.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE: 3145 Aerospace Power Technology	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3145 Aerospace Power Technology	42.993	44.392	30.364	31.667	33.782	34.309	34.804	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the FY 2006 Congressionally-directed Lightweight Photovoltaic Electricity and Hydrogen for Portable, On-Demand Power for Defense Applications in the amount of $1.0 million are in the process of being moved to PE 0602601F, Space Technology, from PE 0602203F, Aerospace Propulsion, for execution. Funds for the FY 2006 Congressionally-directed Advanced Energy Technology for Munitions - Dominator Program in the amount of $2.8 million are in the process of being moved to PE 0602203F, Aerospace Propulsion, from PE 0602602F, Conventional Munitions, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops techniques for efficient energy conversion/storage, power generation/power conditioning/distribution, and thermal management for military aerospace applications. Power component technologies are developed to increase reliability, maintainability, commonality, and supportability of aircraft and flight line equipment. Research is conducted in energy storage technologies to enable the 10-20 year long-term energy storage goals of Air Force unmanned vehicles. Electrical power generation/power conditioning/distribution and thermal management technologies enable 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 radar, high power lasers, and high power microwaves for aerospace platforms. Lightweight power systems suitable for other aerospace applications are also developed.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop power generation/conditioning/distribution, energy conversion/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. Note: In FY 2005, effort to complete testing of an advanced switched reluctance machine controller was transferred to FY 2007 due to delay in obtaining international project agreement.	11.692	11.249	11.679
(U) In FY 2005: Fabricated and tested small-scale lithium-based solid-state cells. Fabricated and tested modular fuel cell systems for manned and unmanned vehicles. Verified dynamic engine models for power extraction through data analysis by independent model.			
(U) In FY 2006: Develop next generation solid state lithium-based electrolyte and develop thin film cells with high voltage battery cathodes. Perform system design and analysis and develop breadboard of a high power fuel cell system for manned and unmanned vehicles.			
(U) In FY 2007: Fabricate and characterize next generation solid state lithium-based thin film cells. Complete testing of an advanced switched reluctance machine controller.			
(U)			
(U) MAJOR THRUST: Develop thermal management, energy conversion/storage and power conditioning components, and subsystem technologies for aerospace applications.	2.749	4.219	4.019
(U) In FY 2005: Integrated vehicle health monitoring algorithms into power distribution unit. Fabricated and performed			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3145 Aerospace Power Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	initial testing of a silicon carbide packaging concept for power electronic device development.			
(U)	In FY 2006: Complete testing a silicon carbide packaging concept for power electronic device development. Initiate efforts to scale-up sub-scale spray cooling flight tests to ten kilowatt (kW) and expand modeling efforts to support the scale-up. Develop flight experiment for two-phase active thermal management system.			
(U)	In FY 2007: Complete scale-up, modeling efforts and flight tests of ten kW spray cooling technology.			
(U)				
(U)	MAJOR THRUST: Develop cryogenic power generation, high rate batteries, energy conversion/storage and power conditioning components, and system technologies with low volume displacement to enable delivery of high power for operation of directed energy weapons. Note: In FY 2006, increase in funding is due to fabrication and test of superconducting generator.	9.451	14.267	14.666
(U)	In FY 2005: Tested advanced pulse power capacitors. Completed testing of liquid dielectric high voltage switches. Tested Bismuth Strontium Calcium Copper Oxide (BSCCO)/ Yttrium Barium Copper Oxide (YBCO) superconducting coils in a rotating test rig for megawatt-class power applications. Completed scale-up and test high rate lithium-ion (liquid) cells. Initiated preliminary design of proof-of-concept superconducting generator.			
(U)	In FY 2006: Develop conductor configuration, test, and deliver a coil of alternating current tolerant high temperature superconducting material. Initiate preliminary design of high rate lithium-ion (liquid) battery system for directed energy applications. Complete design of proof-of-concept superconducting generator and begin fabrication.			
(U)	In FY 2007: Continue design of high rate lithium-ion (liquid) battery system for directed energy applications. Complete fabrication and begin testing proof-of-concept superconducting generator.			
(U)				
(U)	CONGRESSIONAL ADD: Cell-Level Battery Control.	1.461	0.986	0.000
(U)	In FY 2005: Further developed and improved prototype components for monitoring and control of charge and temperature of battery energy storage systems of battery controller for lithium ion battery in man-portable systems and expand efforts to airborne systems.			
(U)	In FY 2006: The individual Application Specific Integrated Circuits and controller will be applied to an application using Li-ion batteries to form a new power supply for the Battlefield Air Operations (BAO) kit. This technology could also be applied to fighter aircraft or for Unmanned Aerial Vehicles (UAV) batteries.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Lightweight Photovoltaics for Portable Power and Hydrogen Generation. Note: In FY 2005, this was referred to as "Photovoltaic Hydrogen and Flexible Photovoltaic for Portable Power."	0.974	0.986	0.000
(U)	In FY 2005: Continued to investigate various photovoltaic solar cells to determine performance characteristics.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3145 Aerospace Power Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Evaluated device designs to incorporate accomplishments from prior years. Determined designs most likely for success and produced a final design based on this determination.			
(U)	In FY 2006: Fabricate multi-junction solar cells on flexible, thin-film substrates. Develop advanced laser scribing and cell interconnection techniques required for the fabrication of high-performance flexible thin-film solar cells. Fabricate and demonstrate flexible thin film photovoltaic modules of 1 sq.ft. Develop photovoltaic electricity converter (PEC) photoelectrodes for hydrogen generation. Develop hydrogen and oxygen catalyst materials for efficient water electrolysis. Develop efficient and durable PEC systems.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Hypersonic Vehicle Electric Power System (HVEPS) Technology.	3.022	0.000	0.000
(U)	In FY 2005: Fabricated and tested subscale 500 kilowatt (kW) supersonic and 100 kW hypersonic magnetohydrodynamic (MHD) generators using modern commercial cryocoolers for the MHD superconducting magnets and high energy fuels to produce high temperatures and electrical conductivity in the MHD channel.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: High Powered Electrical Aircraft Capabilities (HiPEAC).	6.335	0.000	0.000
(U)	In FY 2005: Identified the technologies required to satisfy the capability requirements of emerging high-powered aircraft. Complete designs, fabrication, and tests of critical technologies required for enabling new platform capabilities. Developed and built a ground-based aircraft electric power test bed to demonstrate system level and component level technologies and drive them to mature technology readiness levels.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Center for Security of Large-Scale Systems (LSS).	1.851	1.380	0.000
(U)	In FY 2005: Improved previous and developed new accurate, high-speed computation for the implementation of fast-acting on-line control to enhance security and survivability of military platforms with specific focus on the application of advanced distributed heterogeneous simulation techniques to LSS. Expanded and conducted tests of prototype hardware used to verify and validate the modeling and simulation accuracy.			
(U)	In FY 2006: Apply high-speed computation, based upon distributed heterogeneous simulation, to develop optimization strategies, prognostics, and health monitoring (PHM) systems for military platforms. Apply Distributed Heterogeneous Optimization (DHO) and PHM to prospective military platforms with specific focus on near-space			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3145 Aerospace Power Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	vehicles and more-electric power-optimized aircraft. Conduct tests and use prototype hardware to validate DHO and PHM strategies.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Remote-Base Power Demonstration.	1.461	0.000	0.000
(U)	In FY 2005: Developed materials systems and cell-stack configurations for increasing the power density and improving start-up characteristics for a five kW Auxiliary Power Unit using advanced solid oxide fuel cell technology.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Integrated Cooling and Power System with Magnetic Bearing Turbogenerator.	2.730	0.000	0.000
(U)	In FY 2005: Analyzed, modeled, and developed the system components comprising a complete Integrated Cooling and Power System (ICPS), integrated the Magnetic Bearing Turbo-Generator (MBTG) with these components, and performed system-level ground tests of the entire MBTG-enabled ICPS package.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: High Flux ESC System with TES for Military High Energy Laser (in FY 2005, this congressional add was titled Advanced Cooling Technology for High Flux Military Diode Laser Arrays).	1.267	1.281	0.000
(U)	In FY 2005: Conducted scaling, reliability, and flight test experiments to advance spray-cooling concepts for high flux laser components for space and air vehicles.			
(U)	In FY 2006: Develop spray cooling technology critical for cooling high heat flux tactical lasers on space and air vehicles. Research will focus on scalability and reliability of the evaporative spray cooling thermal management system (TMS). Effort objective is to scale the TMS to cool up to 30 kW of waste heat with an energy storage capacity of 2 Megajoules (MJ). In addition, the cooling system will be designed and evaluated to operate in harsh environmental conditions such as variable gravity and extreme temperatures.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Affordable Lightweight Power Supply Development.	0.000	1.744	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Demonstrate a novel membrane electrode assembly (MEA) employing advanced electrolyte and/or			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3145 Aerospace Power Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	catalysts with vastly superior performance compared to conventional MEAs at high temperatures and low relative humidity. Further development of these systems to improve longevity and mechanical integrity under harsh operating conditions. Construct and test MEAs of various sizes and short-stack fuel cells with enhanced performance that lead to improved power density, reduction in cost per kW of power and the utilization of high energy fuels.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Integrated Power and Aircraft Technologies.	0.000	5.224	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop and demonstrate an integrated power unit (IPU) as a multi-function turbogenerator with maximized power density (kW/ft3) and minimized logistics requirements. Design and demonstrate an engine-internal generator(s) for propulsion engines for an unmanned aircraft. Develop technologies for superconducting generators of 1-5 Megawatt (MW) power range with minimized size/weight requirements for a generator and its cryocooling subsystem. Develop technologies and dynamic models of a 1-5 MW pulse-power generation system for a directed energy application, with a conventional generator as the power source. Develop simulations and models of this 1-5 MW pulse power system in an aircraft-installed configuration to identify energy flow and thermal management requirements as well as benefits in utilizing recent thermal management technologies. Design, build, and demonstrate various components supporting an "all-electric engine" that does not require an external gearbox drive or its accessories.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: MEPS (Multimegawatt Electric Power System) Thermal Management.	0.000	1.380	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Perform trade studies that investigate the possible thermal management approaches to the removal of heat from a high power microwave and the subsequent elimination of this heat from the airborne weapon/power system. Perform a sub-scale thermal management demonstration of the heat removal technique. Develop a technique that prevents over-temperature damage from occurring to the microwave device in the event that the cooling technique ceases to function properly.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Portable Power Solution Employing Chemical Hydrides.	0.000	1.676	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Aide transition of the fuel cell power unit to the Battlefield Renewable Integrated Tactical Energy			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3145 Aerospace Power Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	System (BRITES) through continued refinement of the energy storage cartridge. Various aspects of the cartridge performance will be examined with respect to orientational dependence, ruggedness, and cost effectiveness. Multiple cartridges will be constructed and evaluated and a detailed analysis of their performance and reliability will be presented. Additionally, advanced methodologies for increasing cartridge energy density will be explored. In particular, non-aqueous fuel hydrolysis will be examined.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	42.993	44.392	30.364

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 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 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.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT NUMBER AND TITLE: 33SP Space Rocket Component Tech

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
33SP Space Rocket Component Tech	0.000	0.000	49.305	46.497	48.774	49.726	49.925	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts will transfer from PE 0602500F, Multi-Disciplinary Space Technology, Project 5026, Rocket Propulsion Component Tech, and Project 5027, High Speed Airbreathing Prop Tech, to this BPAC in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops advances in rocket propulsion technologies for space access, space maneuver, and ballistic missiles. Analytical and experimental areas of emphasis are propellants, propellant management, combustion, rocket material applications, Technology for Sustainment of Strategic Systems (TSSS) Phase 1, and novel space propulsion concepts. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of future space and missile launch subsystems. 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 contribute to the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program, a joint Department of Defense, NASA, and industry effort to focus rocket propulsion technology on national needs.

This project also develops revolutionary, airbreathing, hypersonic propulsion technology options to enable affordable, on demand access to space for the Air Force. The short-term focus is on hydrocarbon fueled engines capable of operating over a broad range of Mach numbers and longer term focus will be on hydrogen fueled scramjet powered engines that can enable the higher Mach numbers to achieve access to space. Technologies developed under this program enable capabilities of interest to both the Department of Defense and the NASA. Efforts include modeling and simulation, proof of concept tests of critical components, advanced component development, and ground-based tests.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop, characterize, and test advanced hydrocarbons, energetics, and reduced-toxicity monopropellants to increase space launch payload capability and refine new propellants synthesis methods. Efforts include evaluation and development of reduced-toxicity ionic salt, high-energy-density oxidizers, nano-materials, catalyst, and polymeric binders; determining optimized paths for incorporating these materials into propellants; and for selected propellants perform laboratory and demonstrator engine evaluations. Efforts seek monopropellants with performance equivalent to bipropellants that reduce the cost of space access and space operations. Phases are referring to the IHPRPT program phases.	0.000	0.000	3.259

(U) In FY 2005: Not Applicable.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Further downselect and continue scaling-up promising high energy-density materials candidates. Evaluate scaled-up and new selected propellants in advanced combustion devices to determine materials compatibility and performance to include supporting large-scale motor tests. Continue to model and analyze advanced propulsion concepts with enhanced performance and reliability such as rocket-based combined cycle engines.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 33SP Space Rocket Component Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	MAJOR THRUST: Develop advanced liquid engine combustion technology for improved performance, while preserving chamber lifetime and reliability needs for engine uses in heavy lift space vehicles. Efforts include modeling and analyzing advanced propulsion concepts with enhanced performance and reliability such as aerovehicles and potential launch systems. Phases are referring to the IHPRPT program phases.	0.000	0.000	8.257
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Continue to characterize, study, and evaluate shear coaxial injector performance to ensure chamber/injector compatibility and prevent damage to upper stage engines. Continue to develop, analyze, and transition advanced combustion device technology, including injectors and chambers suitable for advanced synthetic hydrocarbon fuels capable of meeting or exceeding the Phase III goals. Develop improved understanding of fundamental combustion and fluid flow/heat transfer processes leading to new methodologies for thermal management, scaling, and combustion instabilities in hydrocarbon fueled liquid rocket engines, reducing the need for conducting large numbers of costly full-scale component and engine tests. Develop, scale-up, and transition new energetic advanced hydrocarbon fuels and additives for rocket propulsion, including space storable high energy, non-toxic fuels.			
(U)	MAJOR THRUST: Develop advanced material applications for lightweight components and material property enhancements for use in advanced combustion devices and propulsion systems for current and future rocket propulsion systems.	0.000	0.000	4.985
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Continue developing new advanced ablative components using hybrid polymers. Continue to characterize and finalize processing parameters of new nano-reinforced high temperature polymers and scale-up processing of carbon-carbon materials. Continue developing new advanced materials for use with high-energy propellants. Continue to explore using nanocomposites for liquid rocket engine tanks and optimize processing technology using multifunctional nanomaterials.			
(U)				
(U)	MAJOR THRUST: Develop advanced liquid engine technologies for improved performance, while increasing life and reliability needs for engine uses in expendable and reusable launch vehicles.	0.000	0.000	26.539
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Continue development of advanced cryogenic upper stage technologies - turbopumps and thrust			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 33SP Space Rocket Component Tech

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	chambers. Evaluate third set of potential hydrocarbon fuels and adjust/modify/develop fuel characterization test rig. Complete development of second concept for lightweight nozzles for liquid rocket engines. Start hydrocarbon boost technology development for future operationally responsive spacelift concepts.			
(U)				
(U)	MAJOR THRUST: Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for stationkeeping, repositioning, and orbit transfer for large communication satellites, microsatellites, and satellite constellations. Phases are referring to the IHPRPT program phases.	0.000	0.000	6.026
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Continue Hall thruster Phase III development efforts. Continue evaluating Phase III plasma thrusters for microsatellites propulsion systems. Initiate advanced bi-propellant technology developments for satellite thrusters. Initiate advanced hybrid propulsion concept for satellites.			
(U)				
(U)	MAJOR THRUST: Conduct assessments, system design trades, and simulations to integrate combined cycle engines (CCEs) and advanced cycle airbreathing hypersonic propulsion technologies in support of the development of affordable, on-demand access to space vehicles to meet future warfighter needs.	0.000	0.000	0.239
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Conduct system trade studies to determine military payoff and establish component technology goals. Continue to define new component and engine performance objectives to enable development of affordable hypersonic CCEs.			
(U)				
(U)	Total Cost	0.000	0.000	49.305

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Not Applicable.									

(U) D. Acquisition Strategy

Not Applicable

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT NUMBER AND TITLE: 4847 Rocket Propulsion Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4847 Rocket Propulsion Technology	24.711	35.829	15.357	11.132	11.679	11.843	11.974	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops technologies for the sustainment of strategic systems (including solid boost/missile propulsion, post boost control, aging and surveillance efforts) and tactical rockets. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of these systems. Technologies are being accomplished in two phases and are developed to reduce the weight by 15 percent (Phase I)/20 percent (Phase II) and cost of components 25 percent (Phase I)/30 percent (Phase II) through the use of new materials, and improving designs and manufacturing techniques. Aging and surveillance efforts could improve lifetime prediction capabilities by ten years and reduce non-destructive test costs by 50 percent. All efforts in this project are part of the Technology for the Sustainment of Strategic Systems program and support the Integrated High Payoff Rocket Propulsion Technology program.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop missile propulsion and boost technologies for tactical and ballistic missile systems. Efforts support the Technology for the Sustainment of Strategic Systems program - Phase II.	8.769	10.464	7.729

(U) In FY 2005: Enhanced component development and risk reduction efforts for the Phase II ballistic missile technology demonstration. Evaluated a new potential impregnant for use in rapid densification nozzle fabrication technology, using improved strategic propellants for future ballistic missiles to enhance performance and weight. Increased monomer yield from 18 percent to 45 percent, completed downselect for Phase II materials, and furthered demonstration of low-cost, high temperature, non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer components for solid rocket motors. Successfully scaled up from one gallon to ten gallon batches, while formulating and characterizing new propellant formulations using new fuels and oxidizers developed the last couple years for the next phase of advanced solid propulsion. Completed round robin for one model improving agreement between test methodology and understanding while pursuing modeling and simulation tool developments for solid rocket motors. Furthered the development of advanced tactical propulsion components with improved synthesis yield in a precursor used in propellant formulation.

(U) In FY 2006: Enhance component development and risk reduction efforts for the Phase II ballistic missile technology demonstration. Continue development of rapid densification nozzle technology using improved strategic propellants for future ballistic missiles to enhance performance and weight. Continue demonstrating low-cost, high temperature, non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer components for solid rocket motors. Complete formulation and characterization of new propellant formulations using new fuels and oxidizers developed over the last couple of years for the next phase of advanced solid propulsion. Continue modeling and simulation tool developments for solid rocket motors to be used in developing components for the Phase II Missile Propulsion Demonstration. Continue development of advanced tactical propulsion technologies.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 4847 Rocket Propulsion Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Initiate component development and risk reduction efforts for the Phase II Missile Propulsion demonstration. Verify development of rapid densification nozzle technology using improved strategic propellants for future ballistic missiles to enhance performance and weight. Continue demonstrating low-cost, high temperature, non-erosive, lightweight coated carbon-carbon, ceramic and hybrid polymer components for solid rocket motors. Continue development of advanced tactical propulsion technologies. Complete modeling and simulation tool developments for solid rocket motors to be used in developing components for the Phase II Missile Propulsion Demonstration.			
(U)				
(U)	MAJOR THRUST: Develop missile propulsion technologies and aging and surveillance technologies for ballistic missile. Efforts support the Technology for the Sustainment of Strategic Systems program Phase II.	1.762	1.412	7.628
(U)	In FY 2005: Completed the development of analytical solutions to polymer mechanics for the Phase II aging and surveillance technology developments in analysis codes, tools, and inspection tools for improved assessment of ballistic missile aging characteristics and status.			
(U)	In FY 2006: Complete analysis of existing sensor technologies for use in assessment of ballistic missile aging characteristics and status. Initiate an advanced service life prediction technology program developing and applying existing and advanced sensors that can be embedded or attached to solid rocket motors and the aging and surveillance models and tools that can translate and integrate the sensor data into existing aging and surveillance tool suite.			
(U)	In FY 2007: Continue advanced service life prediction technology program developing and applying existing and advanced sensors that can be embedded or attached to solid rocket motors and the aging and surveillance models and tools that can translate and integrate the sensor data into existing aging and surveillance tool suite.			
(U)				
(U)	CONGRESSIONAL ADD: Advanced Vehicle and Propulsion Center (AVPC).	3.899	4.238	0.000
(U)	In FY 2005: Performed technical support for the analysis of alternatives (AOA) for the following key Air Force missions: prompt global strike; land-based strategic deterrent; and operationally responsive space lift.			
(U)	In FY 2006: Perform technical support and analysis for the Prompt Global Strike Analysis of Alternatives (AoA). Conduct facility upgrades to support upcoming testing which support planning efforts for Land-based Strategic Deterrent and Operationally Responsive Spacelift activities.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Jet and Rocket Engine Test Site (JRETS) testing at San Bernardino International Airport.	6.627	17.743	0.000
(U)	In FY 2005: Expanded the test capabilities to include a spacecraft environmental testing capability and upgrade test			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 4847 Rocket Propulsion Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	capabilities at each test stand.			
(U)	In FY 2006: Funds are expected to bring the remainder of the JRETS test capabilities to a fully operational status in support of government and commercial jet and rocket engine test programs.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Advanced Aerospace Vehicle Cooling Technologies. Note: Only to conduct evaluations of aerospace vehicle cooling technologies at the Jet & Rocket Engine Test Site (JRETS) rockets test stand at the San Bernardino International Airport.	0.974	0.000	0.000
(U)	In FY 2005: Performed Congressionally-directed effort for evaluating aerospace vehicle cooling technologies.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Aerospace Lab Equipment Upgrade.	0.974	0.986	0.000
(U)	In FY 2005: Obtained subsonic wind tunnel equipment for university educational and research purposes.			
(U)	In FY 2006: Obtain high speed and visualization tools for university educational and research purposes.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: High Regression Rate Hybrid Rocket Fuels.	0.732	0.986	0.000
(U)	In FY 2005: Conducted analytical and experimental studies to evaluate the feasibility to mature high regression rate hybrid rocket fuels for use in space launch vehicles.			
(U)	In FY 2006: Conduct scale-up testing and technology maturation efforts for high regression rate hybrid rocket fuels for use in space launch vehicles.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Engineering Research Laboratory Equipment Upgrade.	0.974	0.000	0.000
(U)	In FY 2005: Obtained mechanical engineering equipment for university educational and research purposes.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	24.711	35.829	15.357

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 4847 Rocket Propulsion Technology

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0601102F, Defense Research Sciences.

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

(U) PE 0602303A, Missile Technology.

(U) PE 0602500F, Multi-Disciplinary Space Tech.

(U) PE 0603311F, Ballistic Missile Technology.

(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.

PE NUMBER: 0602204F
PE TITLE: Aerospace Sensors

Exhibit R-2, RDT&E Budget Item Justification

DATE: **February 2006**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602204F Aerospace Sensors**

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	92.597	115.689	117.553	105.531	109.491	110.436	111.836	Continuing	TBD
2002	Electronic Component Technology	18.486	22.952	26.910	23.795	24.609	24.109	23.551	Continuing	TBD
2003	EO Sensors & Countermeasures Tech	17.639	22.551	16.495	15.305	16.238	16.435	16.627	Continuing	TBD
44SP	Space Sensors	0.000	0.000	8.882	10.615	10.059	10.225	10.380	Continuing	TBD
4916	Electromagnetic Tech	17.608	15.606	14.333	11.838	12.513	13.054	13.680	Continuing	TBD
5016	Photonic Component Technology	2.869	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5017	RF Processing for ISR Sensors	7.482	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
6095	Sensor Fusion Technology	13.019	17.061	17.548	15.978	16.405	16.618	16.838	Continuing	TBD
7622	RF Sensors & Countermeasures Tech	15.494	37.519	33.385	28.000	29.667	29.995	30.760	Continuing	TBD

Note: In FY 2006, efforts in Project 5016 will transfer to Project 2002 within this PE. Also in FY 2006, efforts in Project 5017 will transfer to Project 7622 within this PE. In FY 2007, Project 44SP, Space Sensors, efforts will transfer from PE 0602500F, Multidisciplinary Space Technology, Project 5028, Space Sensors, Photonics and RF Processors, and Project 5029, Space Sensor and CM Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This program develops the technology base for Air Force aerospace sensors and electronic combat. Advances in aerospace sensors are required to increase combat effectiveness by providing "anytime, anywhere" surveillance, reconnaissance, precision targeting, and electronic warfare capabilities. To achieve this progress, this program pursues simultaneous advances in: 1) generating, controlling, receiving, and processing electronic and photonic signals for radio frequency (RF) sensor aerospace applications; 2) electro-optical (EO) aerospace sensor technologies for a variety of offensive and defensive uses; 3) RF antennas and associated electronics for airborne and space surveillance, together with active and passive electro-optical sensors; 4) technologies to manage and fuse on-board sensor information for timely, comprehensive situational awareness; and 5) technology for reliable, all-weather surveillance, reconnaissance, and precision strike RF sensors and electronic combat systems. Note: In FY 2006, Congress added $2.0 million for 3-D Packaging Technology for High Speed RF; $1.0 million for Phased Array Antenna Control Computer; $4.2 million for Watchkeeper; $1.2 million for the Center for Advanced Sensor and Communications Antennas; $3.3 million for Super-resolution Sensor System; $1.8 million for Minority LEADERS Research Program; $1.0 million for Compact, Ultra-Sensitive Optical Receiver for Smart and Loitering Standoff Weapons; $1.0 million for Stable Articulating Backbone for Ultralight Radar (SABUR); $1.0 million for OMEV; $1.0 million for OPAL; $1.0 million for Advanced Sensor-based Vigilance Technologies; and $5.6 million for Small Disadvantaged Business, Historically Black Colleges and Universities. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary sensor, electronics, and electronic combat technologies.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	93.376	93.263	94.486
(U)	Current PBR/President's Budget	92.597	115.689	117.553
(U)	Total Adjustments	-0.779	22.426	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.071	-1.674	
	Congressional Increases		24.100	
	Reprogrammings			
	SBIR/STTR Transfer	-0.708		
(U)	Significant Program Changes:			

Not Applicable.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE: 2002 Electronic Component Technology	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2002 Electronic Component Technology	18.486	22.952	26.910	23.795	24.609	24.109	23.551	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, efforts in Project 5016 will transfer to this project in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project focuses on generating, controlling, receiving, and processing electronic signals for radio frequency (RF) sensor aerospace applications. The enabling technologies developed under this project will be used for intelligence, surveillance, reconnaissance (ISR), electronic warfare (EW), battlespace access, and precision engagement capabilities. The technologies developed include: exploratory device concepts, solid state power devices and amplifiers; low noise and signal control components; photonic components; high-temperature electronics; signal control and distribution; signal processing; multi-function monolithic integrated circuits; high-speed analog-to-digital and digital-to-analog mixed mode integrated circuits; reconfigurable electronics; power distribution; multi-chip modules; and high density packaging and interconnect technologies. This project also designs, develops, fabricates, and evaluates techniques for integrating combinations of these electronic component technologies. The project aims to demonstrate significantly improved military sensors of smaller size, lower weight, lower cost, lower power dissipation, higher reliability, and improved performance. The device and component technology developments under this project are military unique; they are based on Air Force and other Department of Defense weapon systems requirements in the areas of radar, communications, EW, navigation, and smart weapons.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop compact, affordable, multi-function receiver/exciter and phased array components for communications, Global Positioning System, radar, EW, and ISR sensors. Develop advanced aperture subsystems that support affordable and scalable antenna arrays, as well as enable efficient wideband, multi-function sensors for radar, EW, and communications. Develop receiver and exciter subsystem technologies that enable compact, affordable, multi-function, multi-beam radar and EW systems.	4.908	5.489	9.642

(U) In FY 2005: Developed a digital beamforming (DBF) receiver architecture addressing issues specific to DBF systems, such as coherence of multiple channels, support for digital true time delay, channel equalization, and array calibration. Evaluated affordable DBF-specific Gallium Arsenide (GaAs) RF components (analog-to-digital converters, filters, mixers, etc.) with the technology upgrade plan for Indium Phosphate (InP) RF components into radar and EW digital receiver modules.

(U) In FY 2006: Demonstrate low cost, lightweight subpanel for phased array radar applications. Demonstrate an affordable, compact receiver-on-a-chip by leveraging advances in commercial Silicon Germanium (SiGe) technology for multifunction and reconfigurable sensor systems.

(U) In FY 2007: Develop scalable panel demonstration with multiple panel communication and metrology. Design and demonstrate a distributed receiver/exciter architecture for advanced multifunction systems used in radar and EW sensors for ISR and battlespace access capabilities.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2002 Electronic Component Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	MAJOR THRUST: Develop new microelectronic component technologies for radar, EW, and communications to support ISR, precision strike and battlespace access capabilities using advances in material research and microelectronic fabrication techniques.	0.792	1.136	2.261
(U)	In FY 2005: Developed and demonstrated the proof of concept of limited subarrays and advanced device technologies that are able to withstand extreme temperature and signal environments.			
(U)	In FY 2006: Develop engineering model of advanced photonic modulation components for low loss signal distribution. Demonstrate integrated photonic microsystems.			
(U)	In FY 2007: Develop high performance RF circuits on lightweight and conformal substrates using advanced semiconducting materials and devices.			
(U)				
(U)	MAJOR THRUST: Develop integration and assembly technologies for high performance aerospace phased array sensors. Design and model photonic component technologies for RF distribution and signal processing. Note: Effort completes in FY 2006	1.847	2.865	0.000
(U)	In FY 2005: Developed and demonstrated the complex integration of multiple functions on flexible RF substrates for application on conformal surfaces such as those found on aerospace vehicles.			
(U)	In FY 2006: Design and fabricate advanced components for external and direct modulation of optical sources with high efficiency for RF photonic links used in radar and communications. Demonstrate optical modulation technology with high linearity and dynamic range for ISR, battlespace access, and time-sensitive targeting capabilities.			
(U)	In FY 2007: Not Applicable			
(U)				
(U)	MAJOR THRUST: Develop signal control and low-power consumption components and techniques to reduce both power loss and power consumption for future radar, electronic warfare, and ISR sensors. Develop and integrate adaptable circuit technologies which utilize dynamic elements and low loss signal control for multi-function radar and EW sensors used for ISR and battlespace access capabilities. Develop wideband (multi-octave) component technologies for multi-function RF apertures used in radar and EW sensor systems.	4.303	6.744	10.061
(U)	In FY 2005: Developed new transmit and receive channel technology using advanced semiconductor integration techniques.			
(U)	In FY 2006: Design, implement and characterize low insertion loss tunable filters for advanced RF multifunction front ends. Demonstrate RF transistors with five-fold reduction in parasitic capacitance for equivalent power output. Design and demonstrate Gallium Nitride (GaN) based field-effect devices with enhanced power handling			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2002 Electronic Component Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	capabilities.			
(U)	In FY 2007: Develop and demonstrate adaptable microcircuits for multi-function applications. Characterize and transition reliable wideband power amplifiers for multifunction radar and EW sensor applications. Characterize high reliability GaN based circuits for millimeter wave and Q-band applications.			
(U)				
(U)	MAJOR THRUST: Refine materials and processes for two-dimensional and three-dimensional device interconnects and component protection from the environment. Develop and demonstrate innovative RF component technology that lowers system cost through reduction of design costs, part count, chip size, production costs, and integration costs.	1.054	0.982	0.844
(U)	In FY 2005: Demonstrated and evaluated a two-fold decrease in the cost and size of the mixed-signal assemblies.			
(U)	In FY 2006: Develop advanced component characterization techniques to assess and mitigate failures in emerging semiconductor technologies and to develop predictive failure models.			
(U)	In FY 2007: Design and implement military specific RF components using advanced circuit compaction techniques and latest commercial foundry advances. Characterize and perform trade-space analysis with respect to traditional RF component technologies.			
(U)				
(U)	MAJOR THRUST: Evaluate the integrated tool suite in the modeling, simulation, design, and characterization environment for mixed-signal (digital, RF, microwave, etc.) component development in both advanced and emerging electronic component technologies.	1.582	3.765	4.102
(U)	In FY 2005: Evaluated system-in-a-package/system-on-a-chip tool suite for the modeling, simulation, design, and characterization of mixed-signal (digital, RF, microwave, etc.) components developed for advanced mixed-signal technologies (silicon-on-insulator (SOI), SiGe, Antimonides, InP). Tested in a laboratory environment breadboard SOI and SiGe signal conversion components designed for narrow band (Global Positioning System, air moving target indication) aerospace applications.			
(U)	In FY 2006: Model and transition electrostatic adaptable microsystems for dense signal environments.			
(U)	In FY 2007: Design and initial modeling of next generation wideband gap devices for high power, high temperature, and broadband multi-function systems.			
(U)				
(U)	CONGRESSIONAL ADD: 3-D Packaging for High Speed Radio Frequency (RF).	2.000	1.971	0.000
(U)	In FY 2005: Designed, fabricated and demonstrated an experimental design for 3-D radio frequency sensing microcircuits for military communication, radar, and electronic warfare sensor applications.			
(U)	In FY 2006: Conduct Congressionally-directed effort for 3-D Packaging for High Speed RF.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2002 Electronic Component Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: General Purpose Reconfiguration Signal Processors System.	2.000	0.000	0.000
(U)	In FY 2005: Fully characterized the miniature on-board signal processor feasibility unit. Developed an ISR application specific miniature signal processor that met form, fit, and function requirements.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	Total Cost	18.486	22.952	26.910

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603270F, Electronic Combat Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602204F Aerospace Sensors**	**2003 EO Sensors & Countermeasures Tech**

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2003	EO Sensors & Countermeasures Tech	17.639	22.551	16.495	15.305	16.238	16.435	16.627	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project determines the technical feasibility of advanced electro-optical (EO) aerospace sensor technologies for a variety of offensive and defensive uses. The sensor technologies under development range from the ultraviolet through the infrared (IR) portion of the spectrum. Related efforts include improvements in avionics integration, digital processing, analysis tools, and sensor architectures. One of the project's main goals is to improve EO and related technologies for the detection, tracking, and identification of non-cooperative and difficult targets, such as those obscured by camouflage. This project also develops the passive and active hyperspectral imaging sensors and algorithms needed to enable precision targeting in severe weather. These technologies are critical to future aerospace surveillance and targeting. Other project goals include advanced EO threat warning and countermeasures.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop technology for non-cooperative identification of airborne and ground-based platforms.	2.805	1.905	2.253

(U) In FY 2005: Conducted ground- and air-based testing and demonstrated advanced combat identification (CID) systems with multi-spectral, polarization-based detection and cueing, and active EO target long-range combat identification sensors. Completed integration of advanced 3-D focal planes and algorithms in concept design of high altitude system and performed technology demonstrations in relevant configurations. Extended passive hyperspectral model to emissive spectral region and performed validation experiments with flying testbed. Extended passive EO/IR enhancements by incorporating passive polarization techniques into both modeling and performance assessments. Developed EO system architectures for layered sensing based on multiple platform types for deep penetration and continuous target area coverage.

(U) In FY 2006: Expand ground- and air-based testing and demonstration of advanced CID systems with multi-spectral, polarization-based detection and cueing and active EO combat identification sensors to include 3-D imaging. Begin development of hybrid focal planes and read-out electronics capable of simultaneous multi-discriminant sensing. Complete EO/IR system architectures for layered sensing based on multiple platform types for deep penetration and continuous area coverage.

(U) In FY 2007: Perform off-board cued ground- and air-based testing and demonstration of advanced CID systems with multi-spectral, polarization-based target re-acquisition and active EO interrogation for combat identification including 3-D imaging and vibration sensing. Continue development of hybrid focal planes and read-out electronics capable of simultaneous multi-discriminant sensing. Begin demonstration of EO/IR system architectures for layered sensing based on multiple platform types for deep penetration and continuous area coverage.

(U)

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2003 EO Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST: Develop optical transmitter technology capable of sensing multiple target characteristics for robust non-cooperative target identification.	2.326	3.121	5.713
(U)	In FY 2005: Evaluated performance of multi-function pulsed vibration/imaging sensing system for long-range CID. Completed breadboard active multi-spectral transmitter and evaluated performance for both hard and extended targets. Developed flight capable, long-range, multi-function brassboard sensor. Tailored flight test platform to support testing of long-range air-to-air and air-to-ground systems under development. Performed initial flights for pulsed vibrometer CID sensor.			
(U)	In FY 2006: Begin testing of optical transmitter technologies capable of sensing multiple target characteristics for robust non-cooperative target identification. Begin development of adaptable waveforms for multi-discriminant sensing. Begin laboratory and field tests and utility analysis of multi-function pulsed vibration/imaging sensing system and evaluate performance for long range CID. Perform initial flights for pulsed gated imager and vibration CID sensor. Test breadboard active multi-spectral transmitter and evaluate performance for both hard and extended targets. Continue flight capable, long-range, multi-function brassboard sensor development. Utilize flight test platform to support testing of long-range air-to-air and air-to-ground systems under development. Collect simultaneous passive and multi-function active sensing phenomenology data in airborne environment for difficult target detection analysis including diverse background characterization.			
(U)	In FY 2007: Continue development and testing of optical transmitter technologies including waveforms capable of sensing multiple target characteristics for robust non-cooperative target identification. Continue laboratory and field tests and utility analysis of multi-function pulsed vibration/imaging sensing system and evaluate performance for long-range CID. Perform flight data collections for pulsed gated imager and vibration CID sensor. Complete testing of breadboard active multi-spectral transmitter and evaluate performance for both hard and extended targets. Continue flight capable, long-range, multi-function engineering model sensor development. Utilize flight test platform to support testing of long-range air-to-air and air-to-ground systems under development. Continue collection of simultaneous passive and multifunction active sensing phenomenology data in airborne environment for difficult target detection analysis including diverse background characterization.			
(U)				
(U)	MAJOR THRUST: Develop innovative techniques and components to target difficult objects in degraded atmospheric conditions.	7.314	4.894	4.284
(U)	In FY 2005: Completed high altitude active sensor performance specification and concept design. Completed the evaluation and demonstration of non-mechanical beam steering concepts for high altitude sensor applications including precision pointing, focusing, and wavefront correction. Developed and demonstrated combined EO/radio frequency (RF) aperture. Conducted tests, analysis and evaluation of specialized multi-function laser radar			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2003 EO Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	(LADAR) for detection and characterization of difficult targets. Collected simultaneous passive and multi-function active sensing phenomenology data for analysis of difficult target detection. Defined architecture for advanced EO unmanned aerial vehicle (UAV) based systems to find, fix, and identify difficult targets in challenging environments including the urban environment. Studied integration techniques for combining active and passive EO/IR for enhanced search, detection, location, and identification.			
(U)	In FY 2006: Begin development of techniques and components to target difficult objects in degraded atmospheric conditions. Integrate and evaluate weather/obscurant penetration concepts. Evaluate utility of non-mechanical beam steering concepts for advanced multi-mode sensor applications including precision pointing, focusing, and wavefront correction and extend to common EO/RF aperture implementation. Continue development and demonstrations of combined EO/RF aperture including preliminary sensor configuration. Continue tests, analysis, and evaluation of specialized multi-function LADAR for detection and characterization of difficult targets. Complete optimized architecture definition for advanced EO UAV based systems to find, fix, and identify difficult targets in difficult environments including the urban environment. Incorporate advanced passive and multi-function active sensing methods to exploit all salient target and background phenomenologies. Perform target phenomenology investigations.			
(U)	In FY 2007: Continue development and begin demonstration of techniques and components to target difficult objects in degraded atmospheric conditions. Integrate and evaluate weather/obscurant penetration concepts into system level tests. Demonstrate utility of non-mechanical beam steering for advanced multi-mode sensor applications, including precision pointing, focusing, and wavefront correction. Continue development and demonstrations of combined EO/RF apertures including preliminary sensor configuration. Continue analysis and evaluation of specialized multi-function 3-D LADAR for detection and characterization of difficult targets. Explore implementation of advanced architectures for advanced EO UAV-based systems to find, fix, and identify difficult targets in challenging environments including the urban environment. Incorporate advanced passive and multifunction active sensing methods to exploit all salient target and background phenomenologies. Continue target phenomenology investigations.			
(U)				
(U)	MAJOR THRUST: Develop countermeasure technologies for use against IR- and EO-guided missile threats.	0.797	2.498	2.400
(U)	In FY 2005: Developed specifications for countermeasure techniques to defeat first generation imaging missile seekers. Exploited advanced infrared sensor technology for countermeasure technique refinement. Characterized an imaging missile seeker to establish target-tracking capabilities.			
(U)	In FY 2006: Evaluate countermeasure techniques to defeat first generation IR imaging missile seekers. Continue the exploitation of advanced IR missiles and IR sensor technology for countermeasure technique updates and refinement.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2003 EO Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Initiate development of active sensing technology to defeat multi-band IR sensors.			
(U)	In FY 2007: Continue evaluation of countermeasure techniques to defeat first generation IR imaging missile seekers. Initiate development of second generation IR imaging missile seeker models/simulations for countermeasure technique development. Continue exploitation of advanced IR missiles and IR acquisition sensors for countermeasure technique updates and refinement. Conduct laboratory assessments of active sensing technology to evaluate capabilities against multi-band IR sensors.			
(U)				
(U)	MAJOR THRUST: Develop aerospace missile and laser warning technologies to accurately cue countermeasures.	0.797	1.754	1.845
(U)	In FY 2005: Evaluated advanced multi-color spectral sensor technologies and high spatial resolution imaging for enhanced clutter discrimination techniques for tactical missile warning. Developed an advanced laser warning receiver for airborne pod applications. Developed a space-based laser threat scenario testbed for satellite-as-a-sensor technology evaluations. Developed new laser warning sensor technologies to address ultra-short and tunable laser threats. Developed new laser warning sensor concepts for integration into UAVs and night vision goggles (NVGs).			
(U)	In FY 2006: Complete developing a laser threat scenario testbed for sensor technology evaluations. Continue developing new laser warning sensor technologies to address ultra-short and tunable laser threats. Initiate development of advanced laser warning concepts for aircraft, to include integration into UAVs and NVGs.			
(U)	In FY 2007: Continue developing laser warning sensor concepts for UAVs and NVGs. Continue developing new laser warning sensor technologies to address ultra-short and tunable laser threats. Initiate development of an advanced laser warning concept for integration into tactical aircraft.			
(U)				
(U)	CONGRESSIONAL ADD: Watchkeeper.	1.600	4.140	0.000
(U)	In FY 2005: Developed ultra-wideband RF technology for an unattended ground sensor for perimeter defense.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Watchkeeper.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Super-resolution Sensor System (S3).	2.000	3.253	0.000
(U)	In FY 2005: Developed and tested a high-bandwidth receiver for laser radar through the utilization of many modulated channels and wavelength division.			
(U)	In FY 2006: Conduct Congressionally-directed effort for the Super-resolution Sensor System.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSSIONAL ADD: Optically Pumped Atomic Laser (OPAL).	0.000	0.986	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2003 EO Sensors & Countermeasures Tech

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Conduct Congressionally-directed effort for OPAL.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) Total Cost	17.639	22.551	16.495

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0603253F, Advanced Sensor Integration.									
(U) PE 0602301E, Intelligence System Program.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Sensors

PROJECT NUMBER AND TITLE: 44SP Space Sensors

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
44SP Space Sensors	0.000	0.000	8.882	10.615	10.059	10.225	10.380	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts will transfer from PE 0602500F, Multi-Disciplinary Space Technology, Project 5028, Space Sensors, Photonics, and RF Processors, and Project 5029, Space Sensor and CM Technology, to this project in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project focuses on developing methods of generating, controlling, receiving, transmitting, and processing electronic, photonic, optical, and opto-electronic (mixed) signals for radio frequency (RF) space sensor applications. The enabling technologies will be used for intelligence, surveillance, reconnaissance (ISR), electronic warfare, and precision engagement sensors based in space. This project develops the baseline technologies required to manage and perform on-board space sensor information fusion for timely and comprehensive communications and situational awareness. Through modeling and simulation, this project develops and evaluates innovative electromagnetic and electronic countermeasures for space applications. This project aims to demonstrate significantly improved military space sensors of smaller size, lower weight, lower cost, lower power dissipation, higher reliability, and improved performance. This project also develops and assesses multi-dimensional adaptive techniques in radar technology for affordable and reliable space surveillance and reconnaissance systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop hybrid space-based sensor solutions and reduce associated technology risks. Develop algorithms to solve signal processing challenges specific to spaced-based platforms. Note: in FY 2007, space-based sensor platform technology efforts, previously performed under other major thrusts in the Project , were placed here to show greater emphasis.	0.000	0.000	4.340
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Initiate identification and development of specific techniques and technologies to further expand the capabilities of space-based sensor platforms.			
(U)			
(U) MAJOR THRUST: Develop advanced active phased array antenna subsystems to meet the unique requirements of affordable space based sensing including the restrictions on mass, size, power. Utilize advanced materials to demonstrate low-mass, low cost, reliable and scalable apertures. Supports ISR capability.	0.000	0.000	0.692
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Demonstrate low-mass scalable tiles/panels with advanced thermal management and improved efficiency for active components.			
(U)			
(U) MAJOR THRUST: Study adaptive processing techniques for large, multi-mission, space-based conformal arrays.	0.000	0.000	2.717

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 44SP Space Sensors

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Evaluate adaptive processing techniques suitable for implementation on space-qualified computing architectures for multi-intelligence ISR sensing from space-based platforms. Develop signal processing methods and novel adaptive transmit waveform techniques for a space surveillance platform.			
(U)				
(U)	MAJOR THRUST: Develop advanced photonic component technology for space-based sensors that focuses on improving performance and reducing size, mass, and prime power. Supports ISR capability.	0.000	0.000	1.133
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Develop and model a photonic metrology architecture for large area antennas.			
(U)	Total Cost	0.000	0.000	8.882

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602500F, Multi-Disciplinary Space Tech.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Tech.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Sensors

PROJECT NUMBER AND TITLE: 4916 Electromagnetic Tech

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4916 Electromagnetic Tech	17.608	15.606	14.333	11.838	12.513	13.054	13.680	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops technologies for sensor systems that cover the electromagnetic (EM) spectrum--from radio frequency (RF) to electro-optical (EO). It develops RF antennas and associated electronics for airborne and space-based surveillance. It also investigates RF scattering phenomenology for applications in ground and air moving target indicators in extremely cluttered environments. The project develops active and passive EO sensors for use in concert with RF sensors. It develops low-cost active sensors that use reliable high-performance solid state components for target detection and identification and missile threat warning. The project also develops passive multi-dimensional sensors to improve battlefield awareness and identify threats at long-range.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Investigate detection of difficult airborne and ground-based targets in clutter from airborne or space-based surveillance platforms.	2.581	2.620	3.583
(U) In FY 2005: Developed and validated target and clutter models and innovative measurement techniques for the parametric description of radar signal scattering from targets, terrain, and foliage.			
(U) In FY 2006: Develop integration techniques for combining EM target and clutter physics models with signal processing for improved target detection.			
(U) In FY 2007: Develop integration techniques for multiple platforms, combining EM target and clutter physics models with signal processing for improved target detection.			
(U)			
(U) MAJOR THRUST: Design and develop antennas for airborne and space-based surveillance.	2.625	2.789	3.815
(U) In FY 2005: Designed and analyzed advanced large lightweight array antennas. Fabricated breadboard for large lightweight array antennas. Developed new algorithms for multi-beam digital beam forming and limited-scan phased array antennas. Validated high-speed electronics antenna front-end applications and micro-electro-mechanical systems (MEMS) technology for delay line switching in phased arrays.			
(U) In FY 2006: Develop and demonstrate novel RF and digital hardware architectures and embedded algorithms that achieve wideband digital beamforming for multi-function phased arrays. Analyze and develop advanced 3-D MEMS RF structures that improve RF circuit design flexibility and reduce the size and cost of microwave integrated circuits. Investigate and develop novel designs for rugged, wideband, low-profile conformal antennas for airborne applications.			
(U) In FY 2007: Develop nonlinear embedded algorithms that enhance dynamic range and bandwidth of digital beamforming hardware, enabling the use of lower cost hardware. Demonstrate the integration of microwave integrated circuits into low-cost 3-D MEMS RF structures designed for a miniature seeker radar. Analyze and			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 4916 Electromagnetic Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	develop digital beamforming architectures for conformal phased array antennas for future air-to-air radar system applications.			
(U)				
(U)	MAJOR THRUST: Design and develop new EO techniques and components for detecting and identifying concealed targets.	2.301	2.282	3.121
(U)	In FY 2005: Evaluated multi-function, multi-sensor optical arrays and the associated materials and device technologies for optical beam steering. Evaluated active components and integration techniques for autonomous 3-D laser radar (LADAR) guided munitions and other imaging applications. Evaluated optical processing techniques that compensate for optical aberration in aircraft-generated turbulence.			
(U)	In FY 2006: Test newly developed avalanche photo diodes (APD) integrated with electronic readout circuits. Integrate subcomponents with flash LADAR system and perform live tests to evaluate guidance and range resolution capability. Test and evaluate next generation APD designs and incorporate in 3-D LADAR test-bed. Continue development of quasi-phased matched materials for laser wavelength conversion applications.			
(U)	In FY 2007: Develop Zinc Oxide (ZnO), Aluminum Nitride (AlN) and Gallium Nitride (GaN) semiconductors for high power, high temperature EO applications. Develop single crystal GaN substrates for use in detection of biological agents in clouds and in harsh battlefield environments. Use developed LADAR techniques to extend range of agent and target detection. Develop ZnO, GaN, and AlN-based APDs for increased range and detection sensitivity and for non-line-of-sight covert communications.			
(U)				
(U)	MAJOR THRUST: Develop hardware and software for passive multi-dimensional sensing in the thermal infrared spectral wavelength range at high frame rates.	2.301	2.788	3.814
(U)	In FY 2005: Developed technology for a new dual band tomographically-based sensor system for characterizing energetic battlefield events in real-time. Developed techniques that use hyperspectral, simultaneous dual-band information to increase the validity of target declaration and to reduce false alarms.			
(U)	In FY 2006: Design dual band tomographically based sensor system utilizing Cross Dispersion Prism (CDP) to characterize energetic battlefield events in real-time. Create CDP prototype and begin in-house calibration and performance evaluation. Refine CDP techniques used to validate target declaration and reduce false alarms. Design and develop micro-lens multi-spectral sensor for real-time threat warning and battle damage assessment.			
(U)	In FY 2007: Continue evaluation of CDP-based sensor system performance. Expand evaluation of CDP-based sensor system to field testing of various assets of interest and integration of CDP for target validation and reduction of false alarms. Continue design and development of micro-lens multi-spectral sensor for real-time threat warning and battle damage assessment. Evaluate micro-lens multi-spectral sensor performance for real-time threat warning			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 4916 Electromagnetic Tech

(U)	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	and battle damage assessment.			
(U)				
(U)	CONGRESSIONAL ADD: Center for Advanced Sensor and Communications Antennas.	3.000	1.183	0.000
(U)	In FY 2005: Developed innovative, low-cost designs and fabrication methods to achieve high performance and proliferation of advanced phased array antennas into new military applications.			
(U)	In FY 2006: Conduct Congressionally-directed effort for the Center for Advanced Sensor and Communications Antennas.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Phased Array Antenna Control Computer.	1.300	0.986	0.000
(U)	In FY 2005: Developed control system for a 12-meter diameter dome phased array antenna. Developed beam resource management of multiple simultaneous active receive and transmit apertures on the dome surface. Developed tracking algorithms for large apertures including various approaches to track the fluctuating signals from unstable beams. Developed techniques for remote dome management allowing a remote control center to configure beams and allocate them to individual users. Developed approaches for handling dome health and status information so maintenance requirements can be collected at a remote central site.			
(U)	In FY 2006: Conduct Congressionally-directed effort for the Phased Array Antenna Control Computer.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Optical Maximum Entropy Verification (OMEV). Note: In FY 2005, this Add was titled Optical Signature Recognition for Authenticity Verification.	1.000	0.986	0.000
(U)	In FY 2005: Developed a unique optical signature recognition system for authenticity verification of Department of Defense identification cards and other documents.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Optical Maximum Entropy Verification.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Compact Ultra-Sensitive Optical Receiver for Smart and Loitering Standoff Weapons.	1.000	0.986	0.000
(U)	In FY 2005: Developed a small footprint, ultra-sensitive, eye-safe optical receiver.			
(U)	In FY 2006: Conduct Congressionally-directed effort for a Compact Ultra-Sensitive Optical Receiver for Smart and Loitering Standoff Weapons.			
(U)	In FY 2007: Not Applicable.			
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 4916 Electromagnetic Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	CONGRESSIONAL ADD: Stable Articulating Backbone for Ultralight Radar (SABUR).	1.500	0.986	0.000
(U)	In FY 2005: Developed the mechanical deployment structure for SABUR. Designed the radar truss and the metrology and signal processing needed to maintain coherence and pointing accuracy. Built large-scale working prototypes of the concept.			
(U)	In FY 2006: Conduct Congressionally-directed effort for SABUR.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	17.608	15.606	14.333

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0602702F, Command Control and Communications.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	0602204F Aerospace Sensors	5016 Photonic Component Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5016 Photonic Component Technology	2.869	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, efforts in this project will transfer to Project 2002 within this PE in order to more effectively manage an provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project focuses on designing and developing methods to generate, control, receive, transmit, and process opto-electronic (mixed) signals for radio frequency (RF) sensor aerospace applications. Enabling technologies developed under this project for intelligence, surveillance, reconnaissance (ISR) electronic warfare (EW) and precision engagement sensors include: low noise, aerospace environmentally-qualified signal control components (e.g., electro-optical (EO) switches, micro-opto-electronic mixed signals); EO components for RF links; photonic signal control, distribution, and signal processing; multi-function, aerospace-qualified, opto-electronic intraconnects and interconnects. This project designs, develops, fabricates, and evaluates techniques for integrating various combinations of photonic and electronic technologies. The main purpose is to demonstrate significantly improved military sensors of smaller size, lower weight, lower cost, lower prime power, higher reliability, and improved performance -- as compared to current systems. The device, component, and subsystem technology developments under this project are military unique and based on Air Force and other Department of Defense weapon systems requirements in the areas of radar, sensors, communications, EW, navigation, and smart weapons.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop integrated photonic technology components.	2.869	0.000	0.000
(U) In FY 2005: Laboratory tested and validated high-performance integrated photonic technology link, interconnect, and switching components and subsystems for wideband RF phased array antenna beamforming and control, and for high data rate aerospace sensors and communication systems.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	2.869	0.000	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0603203F, Advanced Aerospace Sensors.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602204F Aerospace Sensors**	PROJECT NUMBER AND TITLE **5016 Photonic Component Technology**

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

(U) PE 0603270F, Electronic Combat Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Sensors

PROJECT NUMBER AND TITLE: 5017 RF Processing for ISR Sensors

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5017 RF Processing for ISR Sensors	7.482	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, efforts in this project will transfer to Project 7622 within this PE in order to more effectively manage an provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops and assesses radar technology for affordable, reliable, all weather aerospace intelligence, surveillance, reconnaissance (ISR) systems. Emphasis is on detecting and tracking surface and airborne targets that have difficult to detect signatures due to reduced cross sections, concealment and camouflage measures, severe clutter, or heavy jamming. Techniques exploited include the use of multiple radio frequency (RF) phenomenologies, multi-dimensional adaptive processing, advanced waveforms, and knowledge-aided processing techniques.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop distributed airborne sensor systems to increase sensitivity and improve location accuracy.	0.413	0.000	0.000
(U) In FY 2005: Demonstrated in the laboratory the proof of concept of RF processing techniques for implementing distributed airborne sensing techniques for detecting, locating, and engaging airborne and ground targets.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Investigate techniques for multi-intelligence data acquisition from a single platform.	2.257	0.000	0.000
(U) In FY 2005: Validated multi-function radar sensing through computer simulations and emulations. Laboratory tested RF processing techniques to minimize the electromagnetic compatibility issues associated with hosting multiple radars, electronic support measure receivers, integrated communications equipment, and electronic attack components on a single platform capable of operating simultaneously. Evaluated methods to mitigate unintentional interferers on the ground and in the air such as commercial broadcast assets, civilian radar assets, and commercial communications systems on multi-intelligence platforms. Developed electronic counter-countermeasure (ECCM) techniques that will enable maintaining a surveillance capability in various advanced jamming scenarios based upon multi-intelligence single platform sensing. Researched advanced ECCM techniques to enable maintaining a surveillance capability in various advanced jamming scenarios based upon multi-intelligence single platform sensing.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop multi-mission aerospace microwave processing algorithms to detect and locate advanced cruise missiles, slowly moving ground targets, and stationary targets in severe clutter and jamming	1.930	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 5017 RF Processing for ISR Sensors

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	environments.			
(U)	In FY 2005: Evaluated multi-mission adaptive radar algorithms to support various operational modes including air and ground target detection, ground target imaging, and electronic protection. Developed advanced waveforms for achieving transmit adaptivity and simultaneous multi-mode operation to improve interference rejection, self-protection, and target identification by exploiting diversity in frequency, delay, polarization, and modulation and coding. Laboratory tested knowledge-aided radar signal processing techniques for improved detection and false alarm control performance in multi-intelligence sensors.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Study and analyze technology for detecting and precisely locating concealed targets using stand off aerospace platforms.	2.247	0.000	0.000
(U)	In FY 2005: Evaluated emerging adaptive processing techniques for knowledge-aided, multi-mission processing and resource management. Developed adaptive processing techniques for multi-mission conformal arrays. Developed and evaluated wideband and polarization adaptive processing techniques for multi-function radar. Investigated distributed processing technology for next generation deep-reach target detection and tracking.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop wideband integrated photonic components.	0.359	0.000	0.000
(U)	In FY 2005: Developed high-performance, low loss, wideband integrated photonic link, interconnect, and switching components and subsystems for all weather space and airborne surveillance and reconnaissance systems. This work was an outgrowth of other work in this project.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop wideband photonic analog-to-digital mixed signal conversion component technologies.	0.276	0.000	0.000
(U)	In FY 2005: Developed high-resolution, ultra-fast, multi-gigahertz wideband photonic analog-to-digital mixed signal conversion component technology for all weather space and airborne surveillance and reconnaissance systems. This work was an outgrowth of other work in this project.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 5017 RF Processing for ISR Sensors

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
(U) Total Cost	7.482	0.000	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603270F, Electronic Combat Technology.									

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Sensors

PROJECT NUMBER AND TITLE: 6095 Sensor Fusion Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
6095 Sensor Fusion Technology	13.019	17.061	17.548	15.978	16.405	16.618	16.838	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops the technologies required to perform management and fusion of sensor information for timely, comprehensive situational awareness, automated target recognition (ATR), integrated fire control, and bomb damage assessment. This project determines the feasibility of technologies and concepts for fire control that help to precisely locate, identify, and target airborne and surface targets. The project emphasizes finding reduced signature targets and targets of opportunity. It will enable new covert tactics for successful air-to-air and air-to-surface strikes.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and assess single and multi-sensor ATR and sensor fusion algorithms for rapidly finding, tracking, and targeting mobile targets.	1.587	2.771	2.905

(U) In FY 2005: Developed improvement in image formation and processing of Synthetic Aperture Radar (SAR) data from Research and Development (R&D) data collections. Developed automated image analysis and truthing tools. Employed synthetic data generation tools to augment and enhance existing R&D and operational data sets. Improved ATR R&D computer and networking infrastructure via software, hardware, and network integration enhancements. Assessed the effectiveness of real-time ATR algorithms for time-critical targets on embedded high-performance computing systems. Laboratory tested multi-sensor and sensor fusion assessment algorithms. Researched ATR performance evaluation theory. Laboratory tested the first multi-sensor ATR performance prediction model.

(U) In FY 2006: Continue to develop improvement in image formation and processing of SAR data from R&D data collections. Complete automated image analysis and truthing tools. Continue development of synthetic data generation tools to augment and enhance collected R&D and operational data sets. Complete initial ATR R&D computer and networking infrastructure via software, hardware, and network integration enhancements. Complete assessing the effectiveness of real-time ATR algorithms for time-critical targets on embedded high-performance computing systems. Continue laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Continue ATR performance evaluation theory research for radar, electro-optical (EO), and multiple sensor ATR technologies. Laboratory test the first multi-sensor ATR performance prediction model. Initiate assessment methods and measures for moving target tracking and identification (ID) approaches using multiple sensor types. Initiate development of analysis methods and measures for assessing automated exploitation and rapid response systems proposed for post-conflict force protection, stability, and security operations.

(U) In FY 2007: Continue to develop improvement in image formation and processing of SAR data from R&D data collections. Continue development of synthetic data generation tools to augment and enhance collected R&D and

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 6095 Sensor Fusion Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	operational data sets. Continue laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Complete initial ATR performance evaluation theory for radar ATR technology and continue for EO and multiple sensor ATR technologies. Laboratory test the first multi-sensor ATR performance prediction model. Continue assessment methods and measures for moving target tracking and ID approaches using multiple sensor types. Continue development of analysis methods and measures for assessing automated exploitation and rapid response systems proposed for post-conflict force protection, stability, and security operations.			
(U)				
(U)	MAJOR THRUST: Develop, evaluate, and demonstrate target signature models to support ATR and sensor fusion algorithm development and testing for reconnaissance and strike mission applications.	6.318	5.362	4.884
(U)	In FY 2005: Evaluated target signature models for signature exploitation of radio frequency (RF) sensors, EO multi-spectral systems, and signals intelligence sensors. Generated synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Evaluated preliminary two-class ATR for EO sensed vibration of tactical ground targets. Developed a synthetic scene data generation capability applicable to large area reconnaissance coverage. Upgraded fidelity of modeling and simulation tools that estimate warfighter effectiveness enhancements enabled by inserting ATR and sensor fusion aids to the reconnaissance and strike components of the time-critical targeting kill chain.			
(U)	In FY 2006: Continue to mature target signature models for signature exploitation of RF sensors, EO multi-spectral systems, and signals intelligence (SIGINT) sensors. Continue to develop, signatures, algorithms, and modeling support for RF and multiple EO phenomenology ATR of tactical ground targets. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Continue developing a synthetic scene data generation capability for RF scenes applicable to large area reconnaissance coverage. Initiate investigation of model-driven spectral signal processing and exploitation techniques. Initiate development of ATR algorithm-driven RF sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high diversity data.			
(U)	In FY 2007: Continue to mature target signature models for signature exploitation of RF sensors, EO multi-spectral systems, and SIGINT sensors. Continue to develop signatures, algorithms, and modeling support for multiple RF and EO phenomenology ATR of tactical ground targets. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support ATR of targets in operationally realistic mission environments. Demonstrate a synthetic scene data generation capability for RF scenes and begin development of an EO scene capability applicable to large area reconnaissance coverage. Continue investigation of model-driven spectral signal processing and exploitation techniques. Continue development of ATR algorithm-driven RF sensor design, new			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 6095 Sensor Fusion Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	modes of operation for existing sensors, and signal processing/exploitation for high diversity data.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate enabling ATR, sensor management, and sensor fusion technologies for target detection, tracking, and identification in intelligence, surveillance, reconnaissance (ISR) and combat identification (CID) applications.	5.114	7.942	9.759
(U)	In FY 2005: Developed exploitable radar features for target detection, tracking, and identification. Conducted laboratory demonstration of advanced algorithms for detection and identification of targets under trees and/or in the presence of heavy camouflage, concealment, and deception. Developed technology that will capitalize on precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Developed capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy.			
(U)	In FY 2006: Begin fusion of exploitable radar, EO/infrared (IR), laser radar (LADAR), and hyperspectral features for target detection, tracking, and ID with sensor management techniques. Continue evaluation of physics-based techniques for target detection and identification for ISR and CID applications. Transition to advanced development programs laboratory demonstrated advanced algorithms for detection and identification of targets under trees and/or in the presence of heavy camouflage, concealment, and deception. Continue development of technology that will capitalize on precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Continue development of capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Initiate research of bio-inspired ATR for robustness. Begin ATR, sensor management, and sensor fusion research for urban ISR from small unmanned aerial vehicles (UAVs).			
(U)	In FY 2007: Continue fusion of exploitable radar, EO/IR, LADAR, and hyperspectral features for target detection, tracking, and ID with sensor management techniques. Continue evaluation of physics-based techniques for target detection and ID for ISR and CID applications. Continue development of technology that will capitalize on precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Begin investigation of pixel level registration techniques. Continue development of capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Continue research of bio-inspired ATR for robustness. Continue ATR, sensor management, and sensor fusion research for urban ISR from small UAVs			
(U)				
(U)	CONGRESSIONAL ADD: Advanced Sensor-based Vigilance Technologies.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 6095 Sensor Fusion Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Conduct Congressionally-directed effort for Advanced Sensor-based Vigilance Technologies.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	Total Cost	13.019	17.061	17.548

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0602602F, Conventional Munitions.									
(U) PE 0603270F, Electronic Combat Technology.									
(U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.									
(U) PE 0603762E, Sensor and Guidance Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Sensors

PROJECT NUMBER AND TITLE: 7622 RF Sensors & Countermeasures Tech

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
7622 RF Sensors & Countermeasures Tech	15.494	37.519	33.385	28.000	29.667	29.995	30.760	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006 efforts in Project 5017 will transfer to this project in order to more effectively manage an provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops and assesses affordable, reliable all weather radio frequency (RF) sensing concepts for aerospace applications covering the range of radar sensors including intelligence, surveillance, reconnaissance (ISR) and fire control, both active and passive. This project also develops and evaluates technology for ISR, fire control radar, electronic combat (EC), and integrated radar and EC systems. It emphasizes the detecting and tracking of surface and airborne targets with RF signatures that are difficult to detect due to reduced radar cross sections, concealment and camouflage measures, severe clutter, or heavy jamming. Techniques exploited include the use of multiple RF phenomenologies, multi-dimensional adaptive processing, advanced waveforms, and knowledge-aided processing techniques. This project also develops the RF warning and countermeasure technology for advanced EC applications. Specifically, it develops techniques and technologies to detect and counter the links and sensors of threat air defense systems and hostile command and control networks. The project also exploits emerging technologies and components to provide increased capability for offensive and defensive RF sensors, including radar warning, RF EC, and electronic intelligence applications.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop affordable RF jamming technology and concepts that enhance aerospace vehicle survivability by degrading enemy radar, missile, and command and control systems. Note: Effort completes in FY 2006.	3.944	1.767	0.000
(U) In FY 2005: Developed a complex signal communication environment simulator that contains both adversary and friendly advanced spread spectrum signals. Developed technology for an advanced digital communications jammer. Conducted exploitation evaluations against new, advanced RF threats. Evaluated results of a laboratory demonstration of phase calibration system for a monopulse countermeasure technique to protect all Air Force platforms.			
(U) In FY 2006: Complete development and test of a complex signal communication environment simulator that contains both adversary and friendly advanced spread spectrum signals. Complete development and test of technology for an advanced digital communications jammer. Complete exploitation evaluations against new, advanced RF threats. Perform exploratory research into development of networked electronic attack techniques.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop advanced waveforms for achieving transmit adaptivity and simultaneous multi-mode operation to improve interference rejection, self-protection, and target identification by exploiting diversity in frequency, delay, polarization, and modulation and coding. Develop technologies and techniques to provide	1.224	5.530	17.835

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 7622 RF Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	significant size, weight, and power (SWaP) reductions in RF sensors compatible with severely constrained unmanned air platforms. Develop technology to enable affordable upgrades to RF signal receivers.			
(U)	In FY 2005: Validated threat identification algorithms for next generation threat warning receivers. Developed affordable wideband RF cueing receiver technology. Evaluated the impact of mixed-signal (digital, RF, microwave, etc.) and mixed-technology (electronics, micro-electro-mechanical, photonics, etc.) component development using advanced and emerging technologies for digital receiver and exciter systems.			
(U)	In FY 2006: Identify and analyze advanced receiver/exciter techniques for operation with temporally and spatially adaptive electronic support (ES) and radar antenna systems. Identify and analyze advanced digital signal processing techniques that support distributed and adaptive ES and radar receiver/exciter sensor systems. Minimize SWaP for advanced apertures and receivers, waveform diversity, assured reference, and machine-to-machine sensor cross cueing. Investigate innovative techniques to provide concurrent RF radar and electronic warfare (EW) with electro-optical (EO) compatibility on a single platform. Develop integrated radar and EW modeling, simulation, and analysis capabilities to address system-level multi-intelligence trades.			
(U)	In FY 2007: Develop and evaluate advanced digital receiver/exciter technologies for ES and radar applications that support multiple degree-of-freedom adaptivity. Develop and evaluate advanced signal processing concepts that seamlessly integrate with receiver technologies to support increased levels of adaptivity for operation in complex signal environments. Continue development to reduce size, weight, and power in RF sensors compatible with severely constrained unmanned air platforms. Refine innovative techniques to provide concurrent RF radar and EW with EO compatibility on a single platform. Determine system-level multi-intelligence trades through integrated radar and EW modeling, simulation, and analysis.			
(U)				
(U)	MAJOR THRUST: Develop robust, ultra-widebandwidth antenna technology for use in operational and future aerospace platform electronic apertures. Develop innovative technologies and architectures for extremely wideband apertures to provide for more functionality on a set of platforms. Research next generation applied RF aperture technology.	2.018	6.376	3.818
(U)	In FY 2005: Developed and laboratory demonstrated advanced wideband transmit/receive channel technology. Evaluated design tools to predict antenna performance installed on host platform models. Laboratory demonstrated techniques that provide low-cost, lightweight phased arrays for low band applications.			
(U)	In FY 2006: Design and model thin profile, wideband arrays for ES receive applications. Design and fabricate array beam steering capability for wideband array jammer transmitter. Design and model compact, wideband direction finding antenna. Extend bandwidth performance of unique, low profile, low-cost antenna element.			
(U)	In FY 2007: Fabricate and test thin profile, wideband receive array. Extend array to accommodate transmit function.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 7622 RF Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	Evaluate performance of directional wideband array transmitter. Fabricate and test compact, wideband direction finding antenna for close in sensing.			
(U)				
(U)	MAJOR THRUST: Develop multi-function RF sensing concepts and RF transformational element level arrays for concurrent multi-mode operation.	4.521	2.207	2.287
(U)	In FY 2005: Modeled and simulated innovative multi-function RF sensing concepts for air and space applications. Developed and evaluated advanced multi-function and multi-intelligence RF sensors for ISR and targeting of time-critical targets with applications in unmanned aerial vehicles and manned aircraft. Planned testbed and designed experiment to support validation of concepts and the subsystem requirements for advanced multi-intelligence sensors.			
(U)	In FY 2006: Fabricate and laboratory test low-cost millimeter wave sensor that provides height indication in addition to azimuth and range for landing in obscured environments. Design distributed position, navigation, and time (PNT) virtual testbed to assess assured reference techniques that achieve optimal multi-function RF sensor fusion for a Common Operation Picture (COP). Extend array simulations to determine technology shortfalls for full element level digital beam forming (DBF).			
(U)	In FY 2007: Develop distributed PNT virtual testbed to assess assured reference techniques that achieve optimal multi-function RF sensor fusion for a COP. Perform systems engineering analysis of concurrent operation to determine multi-mode array performance. Initiate technology development of critical subsystems for element level multi-mode DBF.			
(U)				
(U)	MAJOR THRUST: Develop digital RF receiver/exciter technology to support DBF.	1.982	6.325	1.625
(U)	In FY 2005: Developed and evaluated DBF-specific receiver/exciter technologies that stress reduced size, weight, and power consumption, affordability using advanced digital technologies, RF packaging, and functional integration of the RF receiver, analog-to-digital conversion, digital channelization, and digital time delay beamsteering subsystems. Performed testbed integration of multi-intelligence RF receiver/exciter, aperture, and signal processing subsystems.			
(U)	In FY 2006: Develop and model DBF-specific receiver/exciter technologies that stress reduced size, weight, and power consumption, as well as increased affordability for ES and radar sensor systems. Demonstrate through simulation and laboratory integration the benefits for DBF receiver/exciter technologies for multi-intelligence RF sensor systems.			
(U)	In FY 2007: Demonstrate receiver/exciter technologies that support DBF functionality for advanced electronic support and radar sensor systems. Perform laboratory integration and demonstration of reduced size, weight and			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 7622 RF Sensors & Countermeasures Tech

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
power consumption receiver/exciter technologies that support multi-function RF sensor concepts.			
(U)			
(U) MAJOR THRUST: Design exploratory outdoor time transfer experiments between multiple moving platforms for enhanced situational awareness. Investigate techniques for multi-intelligence data acquisition from a single platform.	1.155	0.956	1.233
(U) In FY 2005: Developed experiments in assured reference to evaluate advanced navigation technologies for network centric warfare applications.			
(U) In FY 2006: Demonstrate critical experiments in innovative time transfer techniques for network centric warfare applications. Develop engineering tools to implement advanced electronic counter-countermeasure (ECCM) techniques. Validate the engineering tools using both synthetic and field collected data.			
(U) In FY 2007: Develop ECCM techniques capable of defeating advanced and evolving threats to long-range ISR platforms. Implement developed techniques through previously developed tools. Develop concept for validation of multi-intelligence sensor technologies.			
(U)			
(U) MAJOR THRUST: Develop advanced waveforms for achieving transmit adaptivity and simultaneous multi-mode operation to improve interference rejection, self-protection, and target identification by exploiting diversity in frequency, delay, polarization, and modulation and coding. Develop multi-platform, multi-mission radar adaptive processing algorithms that improve detection and location performance for advanced cruise missiles, air- and ground-based targets in severe clutter and jamming environments.	0.650	7.064	6.587
(U) In FY 2005: Developed adaptive processing techniques for multi-mission conformal arrays.			
(U) In FY 2006: Evaluate advanced adaptive transmit waveforms for single- and multi-mode operation to improve interference rejection, self-protection, target identification, and ambiguity resolution using temporal, spatial, frequency, and polarization diversity. Initiate optimization of waveforms for multi-sensor, multi-mode operations for moving target indicator (MTI) surveillance platforms. Initiate development of advanced radar signal processing algorithms for multi-sensor, multi-mode operation. Continue to develop wideband and polarization adaptive processing techniques for multi-function radar. Evaluate adaptive processing techniques for multi-mission conformal arrays. Develop distributed processing technology for next generation deep-reach target detection and tracking.			
(U) In FY 2007: Develop optimal waveforms for multi-sensor/multi-mode radar. Develop advanced radar signal processing algorithms that are suitable for multi-sensor, multi-mode operation. Evaluate wideband radar signal processing techniques for MTI surveillance platforms. Evaluate distributed processing technology for next generation deep-reach target detection and tracking.			
(U)			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 7622 RF Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	CONGRESSIONAL ADD: Minority LEADERS Research Program.	0.000	1.774	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for the Minority LEADERS Research Program.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Small Disadvantaged Business, Historically Black Colleges and Universities.	0.000	5.520	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Small Disadvantaged Business, Historically Black Colleges and Universities.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	15.494	37.519	33.385

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603253F, Advanced Avionics Integration.									
(U) PE 0602782A, Command, Control, Communications Technology.									
(U) PE 0602232N, Navy C3 Technology.									
(U) PE 0603792N, Advanced Technology Transition.									
(U) This project has been coordinated through the Reliance									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602204F Aerospace Sensors**	PROJECT NUMBER AND TITLE **7622 RF Sensors & Countermeasures Tech**

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

process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

PE NUMBER: 0602500F
PE TITLE: MULTI-DISCIPLINARY SPACE TECH

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602500F MULTI-DISCIPLINARY SPACE TECH

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	91.773	91.694	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5023	Laser & Imaging Space Tech	7.941	8.044	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5025	Space Materials Development	19.991	19.581	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5026	Rocket Propulsion Component Tech	48.622	49.005	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5027	High Speed Airbreathing Prop Tech	0.175	0.243	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5028	Space Sensors, Photonics & RF Proc	1.806	1.914	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5029	Space Sensor & CM Tech	4.910	1.095	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5081	Space Antennas Tech	1.363	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5082	Optical Networking Tech	6.965	11.812	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2006, efforts in Project 5081 move to Project 5082 and the Air Force increased emphasis on developing optical networks for space-based applications. In FY 2007, Project 5023, Laser and Imaging Space Technology, efforts transfer to PE 0602605F, Directed Energy Technology, Project 6255SP, Laser and Imaging Space Technology; Project 5025, Space Materials Development, efforts transfer to PE 0602102F, Materials, Project 6210SP, Space Materials Development; Project 5026, Rocket Propulsion Component Technology, and Project 5027, High Speed Airbreathing Propulsion Technology, efforts transfer to PE 0602203F, Aerospace Propulsion, Project 6233SP, Space Rocket Component Technology; Project 5028, Space Sensors, Photonics and Radio Frequency (RF) Processes, and Project 5029, Space Sensor and Countermeasure (CM) Technology, efforts transfer to PE 0602204F, Aerospace Sensors, Project 6244 SP, Space Sensors; Project 5030, Applied Space Access Vehicle Technology, efforts transfer to PE 0602201F, Aerospace Vehicle Technologies, Project 6222SP, Applied Space Access Vehicle Technology; and Project 5082, Optical Networking Technology, efforts transfer to PE 0602702F, Command Control and Communication, Project 6266SP, Space Optical Network Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This program advances the technology base in multiple disciplines for future space applications with projects focusing on separate technology areas including: 1) laser and imaging space technologies, which develop concepts for advanced, very long-range optical systems and assess the vulnerability of satellites to the effects of high energy laser weapon systems; 2) space materials, which concentrate on the materials technology base for spacecraft and launch systems to improve affordability, maintainability, and performance; 3) rocket propulsion component technologies, which advance technology in liquid propulsion rocket engines, solid rocket motors, spacecraft and upper stage propulsion, ballistic missiles, and application of advanced materials for rockets to achieve revolutionary launch capabilities; 4) high-speed airbreathing propulsion technologies, which develop advanced and combined cycle engine technologies for revolutionary low-cost access to space; 5) space sensors, photonics, and radio frequency processes, which develop technologies to generate, control, process, receive, and transmit opto-electronic signals for space sensor applications; 6) space sensors and countermeasures technologies, which focus on generation, control, reception, and processing of electronic and electromagnetic signals for space sensor applications in intelligence, surveillance, reconnaissance, warning, electronic combat, and countermeasures; 7) applied space access vehicle technologies, which develop advanced concepts for affordable on-demand access to space; 8) lightweight satellite antenna technology and affordable antenna terminal technology for communications and surveillance; and 9) optical networking technology, which focuses on the space-based laser communications to provide the warfighter with unlimited communications to any place at any time. Note: In FY 2006, Congress added $4.3 million for Engineering Tool Improvement Program

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**

(ETIP), $3.2 million for Space Qualification of the Common Data Link, and $4.2 million for Universal Small Launch Vehicle. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	95.402	81.339	106.114
(U)	Current PBR/President's Budget	91.773	91.694	0.000
(U)	Total Adjustments	-3.629	10.355	
(U)	Congressional Program Reductions	0.000	-0.022	
	Congressional Rescissions	-0.078	-1.323	
	Congressional Increases	0.000	11.700	
	Reprogrammings	-1.892		
	SBIR/STTR Transfer	-1.659		

(U) Significant Program Changes:

Efforts transfer to other programs in FY07 and out to more effectively manage and provide oversight of the efforts.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE: 5023 Laser & Imaging Space Tech

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5023 Laser & Imaging Space Tech	7.941	8.044	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602605F, Directed Energy Technology, Project 6255SP, Laser and Imaging Space Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

Develop advanced, long-range, optical technologies such as advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large, lightweight optics; and optical coatings that support relay mirror systems. Relay mirror systems can greatly extend the range of high-power laser weapons, as well as low-power imaging systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop advanced, long-range, optical technologies such as advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large, lightweight optics; and optical coatings that support relay mirror systems. Relay mirror systems can greatly extend the range of high-power laser weapons, as well as low-power imaging systems.	6.005	6.118	0.000
(U) In FY 2005: Developed dual line-of-sight pointing technology for tracking a satellite with a relay mirror. Developed miniature, micro electro-mechanical systems (MEMS), liquid crystals, and novel adaptive optic devices for both monolithic and phased array telescope systems to be used for imaging and beam projection from space.			
(U) In FY 2006: Investigate two-beam propagation techniques in support of a demonstration which tracks and illuminates a cruise missile through a relay mirror. Investigate critical advanced wavefront control devices for both monolithic and phased array imaging and beam projection from space. Develop selected devices to meet application requirements.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Assess the vulnerability of satellites to the effects of high-energy laser weapons and maintain and update catalogued satellites.	1.936	1.926	0.000
(U) In FY 2005: Updated target system response databases for continued improvement of predictive avoidance analyses and provided data to U.S. Space Command for their performance of Laser Clearinghouse functions. Updated previously completed assessments on catalogued satellites. Enhanced and refined finite state modeling process and models for space systems that should enable rapid characterization of new launches and provided a better estimate of on-orbit space systems capabilities for improved space situational awareness. Updated lethality assessment methodology by anchoring modeling tools to empirical data. Performed finite state modeling of laser targets to better			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5023 Laser & Imaging Space Tech**

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	understand vulnerabilities and identify indicators of battle damage assessment. Incorporated improved algorithms and hardware for rapidly characterizing space objects and new launches into current data fusion workstations needed for satellite assessments and for the space situational awareness mission.			
(U)	In FY 2006: Assess the survivability and vulnerability of aerospace systems to the effects of high-energy laser and other directed energy systems. Update response databases for continued improvement of predictive avoidance analyses and provide data to U.S. Strategic Command for the performance of Laser Clearinghouse functions. Update previously completed assessments on catalogued satellites. Enhance and refine finite state modeling process, physical, and functional models for space systems that will enable rapid characterization of new launches and provide a better estimate of on orbit space systems capabilities for improved space situational awareness. Continue to update assessment methodology by anchoring modeling tools to empirical data. Incorporate improved algorithms and hardware for rapidly characterizing space objects and new launches into current data fusion workstations needed for satellite assessments and for the space situational awareness mission.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	7.941	8.044	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602605F, Directed Energy Technology.									
(U) PE 0603444F, Maui Space Surveillance Systems.									
(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology.									
(U) PE 0603605F, Advanced Weapons Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5023 Laser & Imaging Space Tech

(U) **D. Acquisition Strategy**

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602500F MULTI-DISCIPLINARY SPACE TECH**

PROJECT NUMBER AND TITLE: **5025 Space Materials Development**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5025 Space Materials Development	19.991	19.581	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602102F, Materials, Project 6210SP, Space Materials Development, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops the materials and processing technology base for spacecraft and launch systems to improve affordability, maintainability, and performance of current and future Air Force space systems. Families of affordable lightweight materials are being developed, including metals, polymers, ceramics, metallic composites, and nonmetallic composites to provide new capabilities for spacecraft, ballistic missile, and propulsion systems to meet the future space requirements. Rocket propulsion materials development in this project supports the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program. Advanced high-temperature protection materials are being developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet space and ballistic missile requirements. Materials technologies are also being developed to enable surveillance and terrestrial situational awareness systems and subsystems for space and ballistic missile applications.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop materials and processes to dramatically improve performance, durability, and cost of rocket propulsion systems.	10.205	11.037	0.000

(U) In FY 2005: Evaluated materials in an appropriate test environment for high-speed turbopump housings, ducts, valves, solid rocket casings, insulation, nozzle throats, and spacecraft propulsion. Established performance of test articles with representative geometry using high-temperature metals, ceramics, and composite materials to validate material characteristics and processing capabilities for solid rocket nozzles, throats, and spacecraft propulsion. Evaluated engine component suitability using direct replacement of materials or enabling new design based on established material properties. Evaluated materials for pursuing applications, such as thrust chambers, nozzles, and propellant catalysts at high-temperature, high-pressure, and cryogenic environments.

(U) In FY 2006: Evaluate suitability of materials for high-speed turbopumps, ducts, valves, solid rocket casings, insulation, nozzle throats, and spacecraft propulsion applications. Fabricate subscale articles and test in representative rocket engine environment to validate materials performance. Analyze material behavior in rocket combustion environment for solid rocket nozzles, exit cones, throats, and spacecraft propulsion components. Validate materials performance goals for direct replacement of materials. Evaluate processes for scale-up from coupon-level testing to more complex shapes and sizes. Demonstrate innovative concepts and technologies that could enable new engine designs. Characterize material candidates, analyze material performance, and identify ways to improve thrust chambers, nozzles, and catalysts.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5025 Space Materials Development

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop nanostructured materials technology for insertion into structures, propulsion, and subsystems applications such as rocket engine components and cryogenic components and structures to enable lighter weights, better performance, and lower costs. Note: In FY 2006 only, effort slipped due to higher priorities.	0.324	0.000	0.000
(U)	In FY 2005: Developed nanoparticle and nanostructured fabrication, characterization, processing techniques, and models for the efficient, low-cost assembly of nanomaterials.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop affordable, advanced structural and non-structural materials and processing technologies for Air Force space applications.	6.720	6.993	0.000
(U)	In FY 2005: Established performance of high-temperature metallic, high-temperature protection systems using gamma-titanium-aluminide as an external skin for reusable access to space vehicles. Assessed aluminum-lithium metallic cryotank materials for multiple mission access to space. Explored candidate metallic systems for thin gage structures for component operation in robust high-temperature, long duration cruise or access to space environments. Expanded experimental data and analytical results of liquid oxygen compatibility research. Further derived a more representative test series for composite materials. Developed subscale novel high-temperature protection systems in conditions that simulate representative reentry and high-Mach vehicles flight profiles. Initiated testing of candidate space materials to validate test procedures. Matured all-composite heat-pipe radiators for Air Force space systems. Explored oxidation-protected carbon-carbon materials. Established capability of optically tailorable active thermal control coatings with controlled heat dissipation to provide three-fold increase in service life for spacecraft thermal control. Further developed and evaluated baseline effects of the space environment on thermal control coatings, space lubricants, and other organic/inorganic space materials. Explored wear-resistant materials, lubricants, and Micro-Electro-Mechanical System (MEMS) devices for moving mechanical assemblies on spacecraft. Developed non-oxide ceramic composites for stand-off high temperature protection systems. Evaluated rapid inspection techniques for both advanced ceramic tile and stand-off high-temperature protection system materials. Assessed techniques to validate candidate space materials performance. Established suitability of repair processes for non-metallic space materials.			
(U)	In FY 2006: Develop candidate metallic systems for thin gage structures for component operation in robust high-temperature, long duration cruise or access to space environments. Refine analytical methods to understand behavior of materials in cryogenic environments and analyze liquid oxygen (LOX) compatibility research results			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5025 Space Materials Development

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	through integrated technical working groups with industry and National Aeronautics and Space Administration (NASA). Develop subscale high-temperature protection systems for leading edges, nosetips, and aeroshells for expendable and reusable high-speed vehicle applications. Demonstrate oxidation-protected carbon-carbon materials in environments relevant to high-speed vehicle applications. Develop advanced composite technologies for thermal management and dimensionally stable structural space applications. Develop wear-resistant materials, lubricants, and MEMS devices for moving mechanical assemblies on spacecraft. Evaluate candidate space materials and collect critical data to facilitate materials transition.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop materials and materials processing technologies to enable improved performance and affordability of surveillance, tracking, targeting, and situational awareness systems.	2.742	1.551	0.000
(U)	In FY 2005: Developed electro-optic polymers for optical communications, data links, and radio frequency (RF) system control architectures. Demonstrated the detection performance of very long wavelength alternative materials operating at 40 Kelvin. Investigated materials and process technologies capable of providing solutions for mixed-mode (optical and RF) communications apertures.			
(U)	In FY 2006: Demonstrate electro-optic polymers for optical communications, data links, and RF system control architectures. Explore processes to allow advanced materials design and architecture development for very long wavelength alternative materials operating at 40 Kelvin. Develop materials and materials process technologies for application in combined optical and RF communication system apertures.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	19.991	19.581	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:
(U) PE 0602102F, Materials.
(U) PE 0603112F, Advanced Materials for Weapon Systems.
(U) This project has been coordinated through the Reliance process to harmonize efforts and

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5025 Space Materials Development**

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

eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE: 5026 Rocket Propulsion Component Tech	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5026	Rocket Propulsion Component Tech	48.622	49.005	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602203F, Aerospace Propulsion, Project 6233SP, Space Rocket Component Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops advances in rocket propulsion technologies for space access, space maneuver, and ballistic missiles. Analytical and experimental areas of emphasis are propellants, propellant management, combustion, rocket material applications, Technology for Sustainment of Strategic Systems (TSSS) Phase 1, and novel space propulsion concepts. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of future space and missile launch subsystems. 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 contribute to the IHPRPT program, a joint Department of Defense, NASA, and industry effort to focus rocket propulsion technology on national needs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop, characterize, and test advanced hydrocarbons, energetics, and reduced-toxicity monopropellants to increase space launch payload capability and refine new propellants synthesis methods. Efforts include evaluation and development of reduced-toxicity ionic salt, high-energy-density oxidizers, nano-materials, catalyst, and polymeric binders; determining optimized paths for incorporating these materials into propellants; and for selected propellants perform laboratory and demonstrator engine evaluations. Efforts seek monopropellants with performance equivalent to bipropellants that reduce the cost of space access and space operations. Phases are referring to the IHPRPT program phases.	3.869	3.478	0.000

(U) In FY 2005: Furthered downselection and scaled-up promising high energy-density materials candidates. Evaluated scaled-up and new selected propellants in advanced combustion devices to determine materials compatibility and performance, and addressed ballistic property concerns. Matured solid propellants ingredients into Phase III solid propellant formulations. Initiated efforts to address ablation effects on laser-propelled lightcraft fuel and fuel system. Modeled and analyzed advanced propulsion concepts with enhanced performance and reliability such as rocket-based combined cycle engines.

(U) In FY 2006: Further downselect and continue scaling-up promising high energy-density materials candidates. Evaluate scaled-up and new selected propellants in advanced combustion devices to determine materials compatibility and performance and prepare for large-scale motor tests. Complete initial solid propellants ingredients incorporation into Phase III solid propellant formulations. Complete efforts to address ablation effects on laser-propelled lightcraft fuel and fuel system. Continue to model and analyze advanced propulsion concepts with

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5026 Rocket Propulsion Component Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	enhanced performance and reliability such as rocket-based combined cycle engines.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop advanced liquid engine combustion technology for improved performance, while preserving chamber lifetime and reliability needs for engine uses in heavy lift space vehicles. Efforts include modeling and analyzing advanced propulsion concepts with enhanced performance and reliability such as aerovehicles and potential launch systems. Phases are referring to the IHPRPT program phases.	7.069	8.090	0.000
(U)	In FY 2005: Completed characterizing, studying, and evaluating gas-centered swirl injector performance for hydrocarbon boost engine and increase emphasis on chamber/injector compatibility for upper stage engines. Completed the initial stage of advanced multi-phase modeling and subscale combustion evaluation of new high density refined and advanced hydrocarbon fuels to meet Phase II goals. Completed preliminary selection and modeling for several advanced propulsion concepts.			
(U)	In FY 2006: Initiate characterization, studies, and evaluations of shear coaxial injector performance to ensure chamber/injector compatibility and prevent damage to upper stage engines. Develop experiments to enhance the thermal management of upper stage engines for better performance, chamber life, and reliability. Initiate analysis and test to characterize causes and issues that lead to combustion instability in hydrocarbon fueled liquid rocket engines reducing the need for conducting large numbers of costly full-scale component and engine tests. Develop advanced synthetic hydrocarbon fuels to meet Phase II goals.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop advanced material applications for lightweight components and material property enhancements for use in advanced combustion devices and propulsion systems for current and future rocket propulsion systems.	3.936	5.248	0.000
(U)	In FY 2005: Completed first subset of additional development for advanced ablatives for use in low-cost, sprayable processing. Characterized and developed new high temperature polymers incorporating synergistic effects of multiple nanomaterials and furthered development of a carbon-carbon composite processing method that reduces cost and processing time. Furthered transition of specific advanced high temperature materials to air and space systems to reduce system weight and cost, and increase performance. Explored promising nanocomposites for liquid rocket engine tanks with multi-functional capability (lightweight, inert, in situ passivation).			
(U)	In FY 2006: Develop advanced, recyclable, ablative components using nano-reinforced hybrid polymers that are two times better than previously developed materials. Continue to characterize and develop processing technologies to improve nano-reinforced high temperature polymers and carbon-carbon materials. Continue developing new			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5026 Rocket Propulsion Component Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	advanced materials for use with high-energy propellants. Complete transition of specific advanced high temperature materials to air and space systems to reduce system weight and cost, and increase performance. Develop processing methodology for using nanocomposites for liquid rocket engine tanks.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop advanced liquid engine technologies for improved performance, while increasing life and reliability needs for engine uses in expendable and reusable launch vehicles.	20.160	19.519	0.000
(U)	In FY 2005: Completed initial assessment and continued tool improvement for advanced cryogenic upper stage technologies - turbopumps and thrust chambers. Evaluated first set of potential hydrocarbon fuels and adjust/modify/develop fuel characterization test rig. Completed development of first of two concepts for new lightweight nozzles for liquid rocket engines.			
(U)	In FY 2006: Advance modeling and simulation tool development for advanced cryogenic liquid rocket upper stage technologies. Commence hardware design for advanced cryogenic upper stage technologies - turbopumps and thrust chambers. Evaluate second set of potential hydrocarbon fuels and adjust/modify/ develop fuel characterization test rig. Continue development of second concept for lightweight nozzles for liquid rocket engines.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for stationkeeping, repositioning, and orbit transfer for large communication satellites, microsatellites, and satellite constellations. Phases are referring to the IHPRPT program phases.	4.828	4.292	0.000
(U)	In FY 2005: Completed initial stage developments of monopropellant thruster component technologies for chemical-based space propulsion - catalyst and thrust chamber. Completed Hall thruster Phase II system lifetest and commenced Phase III development efforts. Integrated components and initiated Phase II plasma thruster lifetests for microsatellites propulsion systems. Completed development and test of a controlled solid propellant.			
(U)	In FY 2006: Complete initial development and test of monopropellant thruster component technologies for chemical-based space propulsion. Complete Hall thruster Phase II lifetest and continue Phase III development efforts. Complete Phase II lifetest and begin evaluating Phase III plasma thrusters for microsatellites propulsion systems. Complete development and test of a controlled solid propellant.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Engineering Tool Improvement Program (ETIP).	4.866	4.238	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5026 Rocket Propulsion Component Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2005: Improved existing and developed new modeling and simulation tools to address spacecraft component interactions and solid rocket motor heat transfer, insulation performance, plume dispersion, and liquid rocket engine power balance. Developed the integrated reusable launch vehicle analysis tool, which will be used to determine weight, size and performance of future two-stage-to-orbit vehicle concepts.			
(U)	In FY 2006: Provide additional modeling, simulation tool development for Hall-effect thruster physical models, improvements to the ROCket Engine Transient Simulation graphical user interface, and add rocket-based combined cycle models to the Integrated Propulsion Analysis Tool code for future fully reusable launch vehicle concepts. Add capability to analyze advanced propulsion concepts such as Field Reversed Configuration.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Upperstage Engine Technology (USET).	3.894	0.000	0.000
(U)	In FY 2005: Provided for additional validation hardware and risk reduction to existing core effort to develop advanced modeling and simulation design tools for liquid rocket engines.			
(U)	In FY 2006: Congress added $1.0 million for Upperstage Engine Technology, in PE 0603500F, Multi-Disciplinary Advanced Development Space Technology, Project 5033, Rocket Propulsion Demonstration.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Universal Small Launch Vehicle	0.000	4.140	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Integrate propellant tanks with clusters of axi-symmetric aero-spike engine rocket plug nozzles to gain increases in mission performance by employing a vortex combustion, cold-walled liquid oxygen/methane rocket engine concept. This technology could be used on highly operable, highly reusable space transportation systems.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	48.622	49.005	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0601102F, Defense Research Sciences.									
(U) PE 0602114N, Power Projection									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5026 Rocket Propulsion Component Tech**

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

Applied Research.

(U) PE 0602203F, Aerospace Propulsion.

(U) PE 0602303A, Missile Technology.

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

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

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

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602500F MULTI-DISCIPLINARY SPACE TECH**	**5027 High Speed Airbreathing Prop Tech**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5027 High Speed Airbreathing Prop Tech	0.175	0.243	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602203F, Aerospace Propulsion, Project 6233SP, Space Rocket Component Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops revolutionary, airbreathing, hypersonic propulsion technology options to enable affordable, on demand access to space for the Air Force. The short-term focus is on hydrocarbon fueled engines capable of operating over a broad range of flight Mach numbers and longer term focus will be on hydrogen fueled scramjet powered engines that can enable the higher Mach numbers to achieve access to space. Technologies developed under this program enable capabilities of interest to both the Department of Defense and the NASA. Efforts include modeling and simulation, proof of concept tests of critical components, advanced component development, and ground-based tests.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Conduct assessments, system design trades, and simulations to integrate combined cycle engines (CCEs) and advanced cycle airbreathing hypersonic propulsion technologies in support of the development of affordable, on-demand access to space vehicles to meet future warfighter needs.	0.175	0.243	0.000
(U) In FY 2005: Conducted system trade studies to determine military payoff and establish component technology goals. Defined new component and engine performance objectives to enable development of affordable hypersonic CCEs.			
(U) In FY 2006: Conduct system trade studies to determine military payoff and establish component technology goals. Continue to define new component and engine performance objectives to enable development of affordable hypersonic CCEs.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	0.175	0.243	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0601102F, Defense Research Sciences.									
(U) PE 0602201F, Aerospace Flight Dynamics.									
(U) PE 0602203F, Aerospace									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5027 High Speed Airbreathing Prop Tech**

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

Propulsion.

(U) PE 0602602F, Conventional Munitions.

(U) PE 0602702E, Tactical Technology.

(U) PE 0603111F, 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.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE: 5028 Space Sensors, Photonics & RF Proc	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5028	Space Sensors, Photonics & RF Proc	1.806	1.914	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602204F, Aerospace Sensors, Project 6244SP, Space Sensors, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project focuses on developing methods of generating, controlling, receiving, transmitting, and processing photonic, optical, and opto-electronic (mixed) signals for RF space sensor applications. The enabling technologies will be used for intelligence, surveillance, reconnaissance, electronic warfare, and precision engagement sensors based in space. The project aims to demonstrate significantly improved military space sensors of smaller size, lower weight, lower cost, lower power dissipation, higher reliability, and improved performance. This project also develops and assesses multi-dimensional adaptive techniques in radar technology for affordable and reliable space surveillance and reconnaissance systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Design and develop high performance integrated photonic technologies for use in space. Note: In FY 2006, effort moves to advanced photonic component technology for space-based sensors thrust in this Project.	0.250	0.000	0.000
(U) In FY 2005: Tested and evaluated high performance integrated photonic technology link, interconnect, and switching components and subsystems for wideband radio frequency phased array antenna beamforming/control, and for high data rate space sensors and communication systems.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Design and develop efficient, high coefficient chip-scale optical waveguide technologies. Note: In FY 2006, effort moves to advanced photonic component technology for space-based sensors thrust in this Project.	0.335	0.000	0.000
(U) In FY 2005: Tested and evaluated efficient, high coefficient chip-scale optical waveguide technology for mixed signal component subsystems.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Perform independent modeling, test, and evaluation for space-based sensors. Note: In FY 2006, effort moves to advanced photonic component technology for space-based sensors thrust in this Project.	0.183	0.000	0.000
(U) In FY 2005: Designed and developed photonic digital and analog mixed signal multi-gigahertz component architectures for high data rate space sensors and communication systems.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5028 Space Sensors, Photonics & RF Proc

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Study adaptive processing techniques for large, multi-mission, space-based conformal arrays.	1.038	1.062	0.000
(U)	In FY 2005: Developed adaptive processing techniques suitable for implementation on space-qualified computing architectures for multi-intelligence Intelligence, Surveillance, and Reconnaissance (ISR) sensing from space-based platforms.			
(U)	In FY 2006: Continue to develop adaptive processing techniques suitable for implementation on space-qualified computing architectures for multi-intelligence ISR sensing from space-based platforms. Study signal processing methods and novel adaptive transmit waveform techniques for a space surveillance platform.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop advance photonic component technology for space-base sensors that focuses on improving performance and reducing size, mass, and prime power. Supports ISR capability. Note: In FY 2006, photonics technology efforts move into this thrust from previous major thrusts in this Project.	0.000	0.852	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop and demonstrate photonic component technology enabling low loss true time delay for wideband phased array applications			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	1.806	1.914	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Funding:									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5028 Space Sensors, Photonics & RF Proc**

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

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE: 5029 Space Sensor & CM Tech

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5029 Space Sensor & CM Tech	4.910	1.095	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602204F, Aerospace Sensors, Project 6244SP, Space Sensors, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project focuses on developing processes and techniques for electronic and electromagnetic signal processing for ISR space sensor applications. This project develops the baseline technologies required to manage and perform on-board space sensor information fusion for timely and comprehensive communications and situational awareness. Through modeling and simulation, this project develops and evaluates innovative electromagnetic and electronic countermeasures for space applications.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and integrate microwave technologies for advanced radio frequency apertures and phased array antennas used in military ISR space sensors. Note: In FY 2006, effort moves to array antenna subsystems and advanced materials thrust in this Project.	1.614	0.000	0.000
(U) In FY 2005: Developed T/R channels that are able to withstand radiation, limited or no active cooling, and strong, undesired electromagnetic radiation.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop X-band sub-assemblies based on flexible RF membranes. Note: In FY 2006, effort moves to array antenna subsystems and advanced materials thrust in this Project.	0.478	0.000	0.000
(U) In FY 2005: Developed and investigated approaches and techniques to produce large area (>40 m2) active spaceborne aperture using advanced highly integrated and lightweight RF subassemblies. Demonstrated ten-fold reduction in assembly cost and aperture mass.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop two- and three-dimensional interconnects for space applications. Note: In FY 2006, effort moves to array antenna subsystems and advanced materials thrust in this Project.	0.430	0.000	0.000
(U) In FY 2005: Performed environmental testing of the multi-functional flex assemblies two-dimensional and three-dimensional interconnect approaches to determine their applicability for operation in a hostile environment.			
(U) In FY 2006: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5029 Space Sensor & CM Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop techniques to accurately predict scattering phenomenology associated with electromagnetic radiation. Note: In FY 2005, effort is complete.	0.525	0.000	0.000
(U)	In FY 2005: Completed refinement of the accuracy of exploitation of the scattering phenomenology associated with electromagnetic radiation returned from objects or backgrounds when viewed from space. Evaluated performance and enhancements to target recognition using these techniques.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop space-qualified precision time, position, and velocity sensors capable of operating in jamming environments enabling multiple platform sensor-to-shooter operations. Note: In FY 2006, effort is complete.	1.543	0.339	0.000
(U)	In FY 2005: Developed robust precision time, position, and velocity sensor technologies for multi-platform network centric engagement. Evaluated synergistic global positioning system jamming mitigation techniques for operation in hostile RF environments.			
(U)	In FY 2006: Demonstrate highly accurate and robust precision time, position, and velocity sensor techniques for space-based applications. Develop constructive systems engineering model to assess space-based assured reference techniques in terms of measures of performance and warfighter utility.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop technology to enable affordable upgrades to space-qualified RF signal receivers. Note: In FY 2006, effort terminated due to higher Air Force priorities.	0.320	0.000	0.000
(U)	In FY 2005: Further modeled threat identification algorithms for next generation threat warning receivers. Evaluated state-of-the-art digital and software receiver techniques for radar, electronic warfare, and narrowband space applications.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop advanced active phased array antenna subsystems to meet the unique requirements of affordable space based sensing including the restrictions on mass, size, power. Utilize advanced materials, to demonstrate low-mass, low cost, reliable and scalable apertures. Supports intelligence, surveillance, and	0.000	0.756	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5029 Space Sensor & CM Tech

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	reconnaissance capability. Note: In FY 2006, efforts on advanced RF apertures, membranes, and interconnects move into this thrust from previous major thrusts in this Project.			
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop low-mass shallow-depth microwave antenna panels with integrated active elements and low RF distribution loss.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	4.910	1.095	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602500F MULTI-DISCIPLINARY SPACE TECH**

PROJECT NUMBER AND TITLE: **5081 Space Antennas Tech**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5081 Space Antennas Tech	1.363	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, efforts in this project move to Project 5082 in this PE.

(U) A. Mission Description and Budget Item Justification

This project develops the technology base for satellite antenna technology and affordable terminal technology for communications. Enabling technologies developed under this project for satellite terminals will focus on significantly lowering the life cycle cost communications system ownership, while increasing performance. The project will include new approaches to optical and RF communications transmit and receive technologies to improve network communications performance.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate heterogeneous, seamless, secure, self-configuring, high capacity air/space/surface wireless network, ensuring applicability relevance to space missions. Develop variable data rate, networked data link hardware and the associated RF ground stations for such wireless networks.	1.363	0.000	0.000
(U) In FY 2005: Developed variable data rate, networked data link hardware and the associated RF ground stations. Further continued Optical Local Area Networks and gateways for optical communications between space and airborne assets/platforms. Initiated characterization and development of industry standard single mode optical communications bus for airborne platforms and air-to-air or air-to-ground-to-air RF and laser networked communications.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	1.363	0.000	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology.									
(U) This project has been									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5081 Space Antennas Tech**

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

coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE: 5082 Optical Networking Tech	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5082	Optical Networking Tech	6.965	11.812	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0602702F, Command Control and Communications, Project 6266SP, Space Optical Network Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops the technology base for the next generation of ultra-wide- bandwidth, multi-channeled, air and space-based communications networks on and between platforms. As the application of laser-based, point-to-point communications between satellites emerges, air and space-based optical networks, whose communications capacities are thousands of times greater than current communications satellites, become a realistic possibility. This project will assess and adapt the emerging communication and information technologies, for applications in air and space. This project will explore technologies for implementing photonic chip scale optical Code Division Multiple Access (CDMA) and Wavelength Division Multiplexed (WDM) transceivers and prototype networks, built to demonstrate the benefits associated with the advanced fiber optic, wireless, platform, and satellite networks that can be built from them. This project will develop and demonstrate technology to integrate current Radio Frequency with high data rate Optical LASER communications, along with network management techniques, tools and software to support them. These technologies have potential applications in specific military systems including reliable, high bandwidth, jam-resistant communications at the theater level, and multiplexing of multiple DoD users onto a common networking infrastructure for reduced manning and logistics.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and assess optical network technologies for application in the space environment.	1.576	1.511	0.000
(U) In FY 2005: Completed assessment of next generation Internet arrayed-waveguide grating technologies for application in the space environment. Initiated design and development of a multi-path interconnection network that provides for redundancy, fault tolerance, self-routing and non-blocking switching required for space-based networks. Developed transmission technology and control concepts to support optically networked communications.			
(U) In FY 2006: Complete design and development of a multi-path interconnection network that provides for redundancy, fault tolerance, self-routing and non-blocking switching required for air and space-based networks. Initiate demonstration of highly integrated multi-gigabit optical network with 4 x 4 optical data router and optical backbone interface chips.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop and assess existing and emerging Optical CDMA and WDM modulation schemes and protocols for use in space-based optical networks.	1.529	2.997	0.000
(U) In FY 2005: Developed or adapted, along with industry and academia, appropriate standards to ensure the evolution of open systems architecture for space-based optical networks. Investigated emerging terrestrial optical burst			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5082 Optical Networking Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	switching and optical label switching protocols for applicability to space-based optical networks.			
(U)	In FY 2006: Demonstrate industry standard single mode optical communications bus interface chip for airborne platforms. Initiate design and development of optical burst switching and optical label switching protocols for applicability to air and space-based optical networks. Initiate flight demonstration of industry standard single mode optical communications bus interface chip for airborne platforms.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate heterogeneous, seamless, secure, self-configuring high capacity air/space/surface wireless networks that integrate current RF with high data rate Optical Laser communications.	0.273	4.150	0.000
(U)	In FY 2005: Developed variable data rate, networked data link RF/optical hardware and their associated ground stations.			
(U)	In FY 2006: Initiate design and development of waveform, coding, management, and atmospheric mitigation technologies for a combined RF/laser communications brassboard. Continue characterization and development of industry standard single mode optical communications bus for airborne platforms and air-to-air or air-to-ground RF and laser networked communication.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Establish and maintain a capability to characterize, evaluate, and optimize network components and technologies for space applications. Note: Includes Congressional Add funding of $1.7 million in FY 2005. Additionally, program efforts complete in FY 2005.	2.614	0.000	0.000
(U)	In FY 2005: Developed and evaluated performance of passive and active optical/electronic chip-scale networking components (transmitters, receivers, switches) for CDMA and WDM on board networks operating at gigabits per second. Developed and demonstrated innovative technologies, such as 16-channel WDM laser array on one chip, 16-channel WDM array receivers on one chip, and compact high-speed optical transmission subsystems, that can provide the Air Forces with a secure means of transmitting high-speed data information (imagery, video, audio and text) from various platforms, while decreasing the size, power, and weight.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Internet Protocol Commanding of Satellites.	0.973	0.000	0.000
(U)	In FY 2005: Developed and demonstrated technology allowing a satellite to be commanded by a field commander for obtaining near-real-time sensor data of interest. Developed an end-to-end architecture for command and control			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5082 Optical Networking Tech

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	of a satellite based on a High Assurance Internet Protocol Encryption (HAIPE) architecture, where the interface of the HAIPE command and control system with the ground and Space payload will be fully defined.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Space Qualification of the Common Data Link.	0.000	3.154	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Modify the Common Data Link, previously developed for Joint Surveillance and Target Attack Radar System, U-2, Global Hawk, and Airborne Warning and Control System, and perform qualifications testing for operation in the space environment.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	6.965	11.812	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602702F, Command, Control, and Communications.									
(U) PE 0603789F, C3I Advanced Development.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0602601F
PE TITLE: Space Technology

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602601F Space Technology

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	102.928	104.392	85.594	114.195	129.471	127.847	129.358	Continuing	TBD
1010	Space Survivability & Surveillance	51.965	46.216	44.254	44.917	48.115	49.677	50.198	Continuing	TBD
4846	Spacecraft Payload Technologies	17.054	15.912	15.119	24.988	30.422	29.475	29.906	Continuing	TBD
5018	Spacecraft Protection Technology	2.497	2.367	1.938	2.379	2.516	2.551	2.579	Continuing	TBD
8809	Spacecraft Vehicle Technologies	31.412	39.897	24.283	41.911	48.418	46.144	46.675	Continuing	TBD

Note: Funds for the FY 2006 Congressionally-directed Lightweight Photovoltaic Electricity and Hydrogen for Portable, On-Demand Power for Defense Applications in the amount of $1.0 million are in the process of being moved to this PE from PE 0602203F, Aerospace Power Technology, Project 3145, for execution.

(U) A. Mission Description and Budget Item Justification

This PE focuses on four major areas. First, space environmental protection develops technologies to understand, mitigate, and exploit effects of weather and geophysics environments on the design and operation of Air Force systems. Second, spacecraft payload technologies improve satellite payload operations by investigating advanced component and subsystem capabilities. Third, spacecraft protection develops technologies for protecting U.S. space assets in potential hostile settings. The last major area, spacecraft vehicles, focuses on spacecraft platform, payload, and control technologies, and their interactions. Note: In FY 2006, Congress added $1.5 million for Consortium for Autonomous Satellite Systems, $2.5 million for Integrated Control for Autonomous Space Systems (ICASS), $2.4 million for Nano-reinforced Structures and Advanced Multi-functional Structures for Space Programs, $2.0 million for Large Aperture Deployable Structure Systems for Space, $1.5 million for Elastic Memory Composites, $4.4 million for Converted Silicon Carbide for High Performance Optic Structures, $3.4 million for High-frequency Active Auroral Research Program (HAARP), $2.3 million for Deployable Structures Experiment, and $1.4 million for National Security Research--Signature Exploitation. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary space technologies.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	107.419	84.540	92.178
(U)	Current PBR/President's Budget	102.928	104.392	85.594
(U)	Total Adjustments	-4.491	19.852	
(U)	Congressional Program Reductions	0.000	-0.038	
	Congressional Rescissions	-0.108	-1.510	
	Congressional Increases	0.000	21.400	
	Reprogrammings	-2.845		
	SBIR/STTR Transfer	-1.538		

(U) Significant Program Changes:

Changes to this PE since the Previous President's Budget are due to higher Air Force priorities.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602601F Space Technology	PROJECT NUMBER AND TITLE: 1010 Space Survivability & Surveillance	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
1010 Space Survivability & Surveillance	51.965	46.216	44.254	44.917	48.115	49.677	50.198	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops the technologies to exploit the space environment for warfighter's future capabilities. The project focuses on characterizing and forecasting the battlespace environment for realistic space system design, modeling, and simulation, as well as the battlespace environment's effect on space systems' performance. It includes technologies to specify and forecast the environment from "mud to sun" for planning operations and ensuring uninterrupted system performance, optimize space-based surveillance operations, and allow the opportunity to mitigate or exploit the space environment for both offensive and defensive operations. Finally, this project includes the seismic research program that supports national requirements for monitoring nuclear explosions.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop technologies for specifying, monitoring, predicting, and controlling space environmental conditions hazardous to Department of Defense (DoD) operational space systems in order to improve performance, reduce cost, and increase operational lifetimes.	3.936	4.104	5.054

(U) In FY 2005: Upgraded initial version of dynamic radiation belt specification and forecast model to include extreme solar shock events responsible for the worst radiation conditions. Completed conceptual design of advanced, high-resolution solar telescope and conducted initial and critical design of next-generation solar hazard forecasting tool. Tested novel concepts to detect high-energy space particles using micro- and nano-technology based sensors suitable for inclusion in microsatellite constellations to specify space weather. Conducted initial building empirical solar flare forecast algorithms and developed initial physics based modeling to improve accuracy and lead-times for prediction of debilitating explosive events.

(U) In FY 2006: Initiate development of multi-sensor global data assimilation models for real-time situational awareness of energetic electron hazards to space systems. Validate dynamic radiation belt specification and forecast model with data from geosynchronous and low-Earth orbit DoD satellites. Complete physical design and accomplish Preliminary Program Design Review of next generation, high-resolution solar telescope. Develop autonomous procedures to cross calibrate, quality control, and validate solar magnetic field data from disparate network of ground-based telescopes for use in kinematic and hybrid solar wind models. Complete analysis of promising micro- and nano-technology space plasma and energetic particle sensor concepts and transition into spaceflight hardware development programs.

(U) In FY 2007: Continue development of energetic electron data assimilation models for real-time situational awareness by coupling to dynamic radiation belt model to provide data-driven specification and forecast capability. Initiate coupling of radiation belt model to global geospace environment models to increase accuracy and lead time.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NUMBER AND TITLE 1010 Space Survivability & Surveillance

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	Complete initial predictive model of solar explosive events, including flares, bursts, and coronal mass ejections. Develop concepts for active beam and wave probes of radiation belt dynamics.			
(U)				
(U)	MAJOR THRUST: Develop spectral signature libraries, target detection techniques, and decision aids for application to space-based surveillance, laser weapons, and countermeasure systems, including detection of low-observable targets, and targets and space-based resident space object characterization. Note: In FY 2007, there is an increased emphasis on low-observable target detection.	12.478	13.883	17.088
(U)	In FY 2005: Validated and delivered all-altitude, infrared background radiance model for extended radiance sources and conducted initial analysis of existing infrared observations from space of resident space objects. Upgraded and improved atmospheric turbulence models for use in decision aids for tactical high-energy laser systems. Improved turbulence forecast technology for a turbulence decision aid for high altitude air vehicles. Developed advanced on-chip digital signal processing technologies for real-time hypertemporal detection. Validated day/night spectral exploitation algorithms and related signature databases for specific environments such as littoral, agricultural, desert, and woodlands. Used validated simulations to evaluate candidate technologies for spectral theater surveillance and area search missions.			
(U)	In FY 2006: Develop technologies for visible to infrared wavelength sensing for space-to-space resident space object characterization. Using available airborne and spaceborne data, validate daytime spectral processing algorithms and related signature databases for remaining terrain classes. Use test data and validated simulations to evaluate candidate sensor technologies for spectral theater surveillance and area search missions. Develop real-time hypertemporal processing algorithms and determine optimal parameters for operational system. Improve turbulence forecasting skill, as required, and assist in transition of airborne laser decision aid for testing to operational decision aid status. Perform case studies on existing and improved stratospheric clear air turbulence forecast tools. Address decision aid requirements for tactical high-energy lasers and laser communication systems.			
(U)	In FY 2007: Demonstrate technologies for space-based detection, identification and characterization of for resident space object characterization, environmental monitoring, and missile warning/defense. Develop super-resolution techniques for space-based resident space objects for space situational awareness. Initiate transition of validated spectral processing and exploitation algorithms and related signature databases to appropriate users. With available thermal spectral sensors, validate nighttime spectral processing algorithms and related signature databases for specific environments. Initiate transfer of sensor technologies and architecture concepts to acquisition and operational commands as appropriate. Refine real-time hypertemporal processing algorithms; and continue determination of optimal parameters for operational system. Develop third generation (model) hypertemporal sensor for space. Initiate transition of improved stratospheric clear air turbulence forecast models to Air Force Weather			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **1010 Space Survivability & Surveillance**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Agency. Continue to address technology requirements for transition of operational decision aids for airborne lasers, tactical high-energy laser systems, and laser communication systems.			
(U)				
(U)	MAJOR THRUST: Develop artificial intelligence techniques, forecasting tools, and sensors for improved ionospheric specification and forecasting, including communications/navigation outage forecasting (C/NOFS), space-based geolocation demonstrations, and determination and prediction of radar degradation.	6.501	6.649	5.459
(U)	In FY 2005: Generated communication/navigation outage nowcasts and forecasts due to ionospheric scintillation to give the warfighter improved battlefield situational awareness and operational flexibility. Developed validated ionospheric specification and forecast models and products using results from military evaluation of the C/NOFS Advanced Concept Technology Demonstration (ACTD). Investigated ionospheric scintillation technologies to develop techniques for longer-term outage forecasting. Completed pole-to-equator scintillation specification model giving global real-time hazard alerts. Coupled magnetospheric data assimilation and forecast models to validated ionospheric electron profile models to improve geolocation accuracy and increase forecast lead times for radar operations. Developed combined laboratory/field tests to demonstrate feasibility of receiver and transmitter technologies to mitigate hazardous scintillation conditions.			
(U)	In FY 2006: Generate nowcasts and forecasts of communication/navigation outages due to ionospheric scintillation using C/NOFS space and ground system to give the warfighter improved space and battlefield awareness and operational flexibility. Perform metric tests making standardized comparisons between C/NOFS forecast model and product output parameters and selected available measurements to assess effectiveness of scintillation forecasting process. Develop statistical database and tools to track C/NOFS forecast metrics to assess military utility of outage warning due to scintillation. Develop technology to produce artificial ionization patches for use in over-the-horizon radar/comm applications and to mitigate scintillation conditions. Develop specification and forecast models and applications that exploit international network of ionospheric sensors.			
(U)	In FY 2007: Perform metric tests of C/NOFS scintillation forecasting system. Integrate C/NOFS results into ionospheric specification and forecasting algorithms and models for enhanced military utility of scintillation warning system. Investigate coupled solar-magnetospheric-ionospheric-thermospheric models to improve forecast lead times for radar operations, and communications/navigation outages. Develop portable ionospheric sensor suite for measuring total electron content and communications/navigation scintillation.			
(U)				
(U)	MAJOR THRUST: Develop High-frequency Active Auroral Research Program site transmitting and diagnostic instrument infrastructure.	10.588	10.000	9.757
(U)	In FY 2005: Populated the high frequency transmitter array to its full capacity of 180 array elements and 3.6			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NUMBER AND TITLE 1010 Space Survivability & Surveillance

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
megawatt radiated output power.			
(U) In FY 2006: Complete 180-element high frequency transmitter array with 3.6 megawatt radiated power capacity.			
(U) In FY 2007: Validate performance of 3.6 megawatt transmitting array in Extremely Low Frequency/Very Low Frequency (ELF/VLF) wave generation and optical emissions research programs.			
(U)			
(U) MAJOR THRUST: Develop basic seismic technologies to support national requirements for monitoring nuclear explosions with special focus on regional distances less than 2,000 kilometers from the sensors.	6.551	6.849	6.896
(U) In FY 2005: Provided updated seismic codes for operational use. Researched efforts on seismic energy partition (shifting focus towards in situ measurements below the source), magnitudes, and source physics; seismic calibration; seismic detection, location, and discrimination; and observational studies of seismic wave propagation, including propagation in Eurasia. Assessed future direction of seismic research based on results obtained so far and conducted seismic research on these and other topics of interest to the Air Force.			
(U) In FY 2006: Provide further updated seismic codes for operational use. Focus on seismic energy partition, magnitudes, and source physics moves from hypothesis development towards major hypothesis flyoff. Continue efforts on seismic calibration; seismic detection, location, and discrimination; and observational studies of seismic wave propagation, including propagation in Eurasia. Initiate focus on transition between local and regional seismic wave propagation and implications for all topics above. Continue assessment future directions based on results obtained so far.			
(U) In FY 2007: Continue to update seismic codes for operational use. Develop hypothesis test results into potential discrimination and yield estimation techniques, while addressing unresolved hypothesis issues for seismic energy partition, magnitudes, and source physics. Incorporate seismic energy partition effects into implications for local and regional seismic wave propagation. Continue efforts on seismic calibration; seismic detection, location, and discrimination; and observational studies of seismic wave propagation, including propagation in Eurasia. Continue assessment future directions based on results obtained so far.			
(U)			
(U) CONGRESSIONAL ADD: High-frequency Active Auroral Research Program (HAARP).	5.370	3.351	0.000
(U) In FY 2005: Developed Ultra High Frequency radar and optical diagnostic infrastructure at the HAARP site. Provided facility management and environmental oversight functions. Conducted research programs to develop key engineering parameters related to exploiting ELF/VLF waves generated in space for subsurface communications, the imaging of underground structures, and the reduction of charged particle concentrations in the earth's radiation belts.			
(U) In FY 2006: Conduct Congressionally-directed effort for HAARP.			
(U) In FY 2007: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NUMBER AND TITLE 1010 Space Survivability & Surveillance

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	CONGRESSIONAL ADD: Electromagnetic Gradiometer (EM) Gradiometer for the Detection and Confirmation of Underground Hiding Places & Passageways.	2.733	0.000	0.000
(U)	In FY 2005: Developed covert man portable hardware system using remote Very Low Frequency illumination. Assessed the viability of a small, low-flying Unmanned Aerial Vehicle based system using a higher frequency local illuminator for detection of detonation wires on Improvised Explosive Devices. Conducted initial development of demonstration system for unmanned, randomly distributed array and explored preliminary field-testing of system concept.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Seismic Monitoring Program.	2.733	0.000	0.000
(U)	In FY 2005: Performed academic and industry research that will enable operational monitoring of high priority areas of U.S. national concern that would be otherwise inadequately monitored in the near-term. This research supports the Air Force Technical Application Center mission of global nuclear explosion monitoring.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: USAF Center for National Security Research - Signature Exploitation/National Security Research - Signature Exploitation.	1.075	1.380	0.000
(U)	In FY 2005: Developed engineering model smart single detectors and small smart detector arrays with very large dynamic range, broad range of integration times, very large frame rates, local data storage, and in-line processing for each detector element. Ground tests were done on the first generation.			
(U)	In FY 2006: Conduct Congressionally-directed effort for National Security Research - Signature Exploitation.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	51.965	46.216	44.254

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0305111F, Weather Systems.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **1010 Space Survivability & Surveillance**

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

(U) PE 0305160F, Defense Meteorological Satellite Program.

(U) PE 0601102F, Defense Research Sciences.

(U) PE 0602204F, Aerospace Sensors.

(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.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602601F Space Technology	PROJECT NUMBER AND TITLE: 4846 Spacecraft Payload Technologies	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4846	Spacecraft Payload Technologies	17.054	15.912	15.119	24.988	30.422	29.475	29.906	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, decrease in funding is due to higher Air Force priorities.

(U) A. Mission Description and Budget Item Justification

This project develops advanced technologies that enhance spacecraft payload operations by improving component and subsystem capabilities. The project focuses on four primary areas: (1) development of advanced, space-qualified, survivable electronics, and electronics packaging technologies; (2) development of advanced space data generation and exploitation technologies, including infrared, Fourier Transform hyperspectral imaging, polarimetric sensing, and satellite antenna subsystem technologies; (3) development of high-fidelity space simulation models that support space-based surveillance and space asset protection research and development for the warfighter; and (4) development of advanced networking, radio frequency, and laser communications technologies to support next generation satellite communication systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop advanced infrared device technologies for space applications that enable hardened space detector arrays with improved detection, to perform acquisition, tracking, and discrimination of space objects such as decoys, satellites, and warheads throughout their trajectory.	3.553	3.636	3.317

(U) In FY 2005: Incorporated design changes into the fabrication process and advanced wafer growth of strained-layer superlattice detector structures and other promising technologies. Investigated wafer growth of strained-layer superlattice detector structures and other promising technologies as alternatives to mercury cadmium telluride developing both improved performance at a given operating temperature and comparable performance at higher operating temperatures. Evaluated promising "on-focal plane array (FPA)" polarimetric concepts developed to meet projected capability requirements of the next generation space systems. Investigated wavelength agility in detectors. Extended investigation of proton-damage in long wavelength infrared focal plane arrays in the space-relative environment.

(U) In FY 2006: Continue studies in metal films. Demonstrate two-layer single-pixel polarimeter. Improve quantum dot detector responsivity. Continue characterizing superlattice detectors. Continue investigating magnetic and electric field tuning of detector wavelength responsivity ("wavelength agility"). Perform comparisons of emerging detector technologies for transfer to applied research. Characterize and assess performance of long wavelength infrared focal plane arrays developed with radiation hardened-by-design process.

(U) In FY 2007: Pursue detector response tunability. Complete assessment of quantum interference towards amplification of incoming weak signals. Study radiation damage of very long wavelength and visible FPAs.

(U)

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NUMBER AND TITLE 4846 Spacecraft Payload Technologies

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST: Develop spectral sensing and data exploitation methodologies for military imaging and remote sensing applications.	0.790	0.987	0.899
(U)	In FY 2005: Completed assessment and documentation of electro-optical/infrared spectral polarimetric phenomenology understanding. Demonstrated validated polarimetric signature model capability and developed new code upgrades and validation with measured data from on-going field collections. Demonstrated integration of spectral polarimetric models into scene simulation architecture for space-based surveillance applications.			
(U)	In FY 2006: Complete development and continue validation of polarimetric scene modeling capability for space-based surveillance applications. Integrate additional models for accurate prediction of satellite materials signatures and compare with available laboratory and field data. Complete development of instrument models for staring polarimetric surveillance systems. Develop polarimetric and spectral measurement and database of relevant materials for inclusion in the model.			
(U)	In FY 2007: Complete validation of polarimetric scene and signature modeling capability, comparing simulated data to measured field data. Complete initial polarimetric database of materials for use in signature and scene modeling. Define concepts for polarimetric or multi-band imaging sensors for space-based space surveillance applications.			
(U)				
(U)	MAJOR THRUST: Develop technologies for space-based payload components such as low power, high performance, radiation-hardened electronic devices, micro-electro-mechanical system devices, and advanced electronics packaging for next generation high performance space electronics.	3.501	3.726	3.472
(U)	In FY 2005: Researched radiation effects in electronics built with hardness-by-design methods at state-of-the-art manufacturing plants. Evaluated chalcogenide-based reconfigurable electronics providing ten-fold performance improvement and self-repair capabilities. Built monolithically integrated low-power, silicon-based quantum-sized devices for system-on-a-chip applications. Established tools for hardness-by-design part manufacture and demonstrated ten-fold decrease in manufacturing cost. Designed switches on chip, board, and intra-board level supporting self-adaptable, self-healing spacecraft hardware. Developed and evaluated architectures and packaging approaches in support of reconfigurable space systems.			
(U)	In FY 2006: Design new chalcogenide materials for reconfigurable radio frequency (RF) circuits and for reconfigurable wiring. Develop fundamental understanding of exotic high-dielectric constant materials and predict candidate materials for insertion into aggressively scaled electronic devices for space electronics. Research radiation effects in highly integrated microelectronics employing the most recent techniques in power management, clock domain partitioning, and monolithic integration of multiple radio frequency, analog, and digital functions. Identify and evaluate radiation hardening techniques for enhancing immunity to single event and other radiation effects arising from the natural space environment, as well as nuclear events. Develop a "liquid manifold" approach based			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NUMBER AND TITLE 4846 Spacecraft Payload Technologies

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	on combining micro-electromechanical switches and reconfigurable wiring and demonstrate operation.			
(U)	In FY 2007: Complete study of dynamics of phase change materials, and of their interactions with pertinent technological materials. Explore use of polymers in reconfigurable electronics. Continue study of alternative dielectrics for advanced electronics, especially the nitrided oxides. Initiate a nanotechnology collaboration with the Air Force Research Laboratory Materials Directorate. Research radiation effects mitigation schemes using best commercial practices in design and manufacturing to identify new methods for creating radiation hardened, long-lifetime, commodity and custom mixed signal microcircuits for next generation space and missile systems. Evaluate devices using advanced hardening techniques to determine robustness and compatibility with state of the art design and fabrication technology. Develop morphable electronic panels suitable for demonstration in a relevant environment.			
(U)				
(U)	MAJOR THRUST: Develop modeling, simulation, and analysis tools for space-based surveillance systems, rendezvous and proximity operations, optical/infrared imaging space systems, distributed satellite architecture, and space control payloads.	2.912	2.441	2.218
(U)	In FY 2005: Readied the simulation architecture to support flight experiment simulation and data validation for experiments on autonomous command/control software and responsive space technologies. Extended to the simulation architecture to address missions associated with responsive space, space capability protection, and counterspace. Develop enhancements to optical/infrared imaging system simulation to include polarimetric and hyperspectral effects.			
(U)	In FY 2006: Support autonomous and responsive space flight experiments with simulations and data validation. Extend the simulation architecture to feed engineering-level data to mission/campaign models. Extend the architecture to address missions associated with space situational awareness and tactical surveillance. Continue to develop enhancements to imaging system simulations to include polarimetric and hyperspectral effects. Tailor toolset and methodology developed for the multi-aperture strategic system feasibility study for tactical applications.			
(U)	In FY 2007: Continue to support autonomous and responsive space flight experiments with simulations and data validation. Continue to extend the simulation architecture to feed engineering-level data to mission/campaign models. Ready the simulation architecture to support flight experiment simulation and data validation for experiments on space situational awareness and tactical surveillance.			
(U)				
(U)	MAJOR THRUST: Develop bandwidth efficient modulation and high bandwidth communications technologies to support next generation satellite communication systems. Note: In FY 2006, efforts terminated due to higher Air Force priorities.	1.769	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NUMBER AND TITLE 4846 Spacecraft Payload Technologies

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2005: Further explored architecture studies and guide technology investment in support of satellite communications roadmap. Expanded development of technology standards and system designs for integrating multiple airborne intelligence, surveillance, and reconnaissance assets into single space platforms.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop technologies for multi-access laser communications terminals. Assess the maturity of single access terminal components and their applicability to a multi-access terminal design.	4.529	5.122	5.213
(U)	In FY 2005: Developed standards for combining multiple airborne intelligence, surveillance, and reconnaissance and space asset feeds into a single optical data path. Designed laboratory multi-access terminal testbed.			
(U)	In FY 2006: Start verification of standards of combining multiple airborne intelligence, surveillance and reconnaissance and space asset feeds into a single optical data path. Perform component testing using laboratory testbed.			
(U)	In FY 2007: Finish verification of standards of multiple airborne intelligence, surveillance and reconnaissance and space asset feeds into a single optical data path. Perform system testing using laboratory testbed.			
(U)	Total Cost	17.054	15.912	15.119

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 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.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602601F Space Technology	PROJECT NUMBER AND TITLE: 5018 Spacecraft Protection Technology	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5018 Spacecraft Protection Technology	2.497	2.367	1.938	2.379	2.516	2.551	2.579	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops the technologies for protecting U.S. space assets in potential hostile environments to assure continued space system operation without performance loss in support of warfighter requirements. The project focuses on identifying and assessing spacecraft system vulnerabilities, developing threat warning technologies, and developing technologies to mitigate the effects of both intentional and unintentional threats.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop key satellite threat warning technologies and tools for high value satellite asset defense.	0.812	0.898	0.853
(U) In FY 2005: Updated micro-satellite threat characteristics. Selected most promising proximity sensor technology and initiate development of an experimental proximity sensor. Designed and developed ground demonstration plan for the purpose of confirming proximity sensor performance.			
(U) In FY 2006: Begin process of integrating most promising proximity or threat warning sensor into a space experiment. Identify potential of multiple usage of sensor to detect threats and measure environmental phenomenon associated with space flight (weather experiments, debris analysis, assist in navigation, etc.).			
(U) In FY 2007: Conduct sensor space flight experiment and analysis. Identify technology transfer opportunities and report findings to major commands.			
(U)			
(U) MAJOR THRUST: Develop high value space asset defensive capabilities.	0.538	0.588	0.552
(U) In FY 2005: Selected most promising defensive technologies and begin development of experimental defensive capabilities. Designed and reported ground and space demonstration plan for the purpose of confirming defensive capability performance.			
(U) In FY 2006: Select the most promising defensive technology and begin space experiment planning and integration. Identify potential of multiple use technology to detect threats and measure environmental phenomenon associated with space flight (weather experiments, analysis debris, assist in navigation, etc.).			
(U) In FY 2007: Conduct defensive technology space demonstration and post flight analysis. Identify technology transfer opportunities and report findings to major commands.			
(U)			
(U) MAJOR THRUST: Develop techniques to exploit existing on-board inherent satellite resources, satellite-as-a-sensor, and self-aware satellite technologies as a first-line threat detection system.	0.532	0.580	0.533
(U) In FY 2005: Conducted laboratory proof-of-concept for selected subsystems with ground simulation demonstration			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NUMBER AND TITLE 5018 Spacecraft Protection Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	of a combined satellite-as-a-sensor system. The simulation included data fusion, unique radio frequency location tool, simulated laser sensor, simulated proximity sensor, and satellite-as-a-sensor test bed.			
(U)	In FY 2006: Develop space experiment of existing cooperative onboard system or develop proof of concept space experiment to validate concept.			
(U)	In FY 2007: Transition technology to other compatible space systems for multiple use protection.			
(U)				
(U)	MAJOR THRUST: Develop techniques for monitoring and assessing electromagnetic interference and compatibility between ultra-sensitive payload sensors for space systems that support space weather forecasting. Note: Effort is complete in FY 2006.	0.615	0.301	0.000
(U)	In FY 2005: Performed measurements of key ionospheric and scintillation parameters needed for input to ionospheric specification and forecast models. Assessed data for electromagnetic interference effects on ultra-sensitive payload sensors.			
(U)	In FY 2006: Conduct space experiment demonstration of C/NOFS. Assess payload performance in measuring ionospheric and scintillation parameters needed for space weather support in theater and for mission planners and other users.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	2.497	2.367	1.938

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(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.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602601F Space Technology	PROJECT NUMBER AND TITLE: 8809 Spacecraft Vehicle Technologies	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
8809	Spacecraft Vehicle Technologies	31.412	39.897	24.283	41.911	48.418	46.144	46.675	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the FY 2006 Congressionally-directed Lightweight Photovoltaic Electricity and Hydrogen for Portable, On-Demand Power for Defense Applications in the amount of $1.0 million are in the process of being moved to this PE from PE 0602203F, Aerospace Power Technology, Project 3145, for execution."

(U) A. Mission Description and Budget Item Justification

This project focuses on seven major space technology areas: spacecraft platforms (e.g., structures, controls, power, and thermal management); space-based payloads (e.g., survivable electronics); satellite control (e.g., software for autonomous distributed satellite formation flying, signal processing, and control); modeling and simulation of space-based systems; satellite protection technologies (e.g., space environment effects, debris prediction, and threat warning/attack reporting); microsatellite technologies; and space experiments of maturing technologies for space qualification.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop technologies for advanced space platform subsystems such as cryocoolers, compact, high efficiency solar power cells and arrays, and innovative power generation concepts.	3.677	3.586	3.210
(U) In FY 2005: Built second-generation empirically verified thermo-physical performance models for cryocooler regenerators. Further investigated technology development to improve cryocooler capability and performance for regenerative and recuperative cycle cryocoolers. Build modeling and simulation capability for complex thermodynamic cycle coolers. Developed a 30% efficient crystalline multi-junction solar cell based on lattice-mismatch technology. Fabricated 10% efficient thin-film, monolithically integrated solar cell.			
(U) In FY 2006: Build experimental capabilities for flow field measurements in pulse tube cryocoolers. Refine and validate cryocooler component and system models with experimental data. Investigate thermodynamic loss mechanisms in regenerative cycle cryocoolers through computational fluid dynamics models. Demonstrate 12% efficient thin-film solar cell on polymer substrate. Demonstrate five- or six- junction solar cell.			
(U) In FY 2007: Develop component-based system model of pulse tube cryocoolers for parametric optimization of cryocooler system design. Design an ultra low-temperature (10 degrees Kelvin), low mass and high efficiency advanced engineering model cryocooler. Transition optimal design methodologies to cryocooler industry. Demonstrate greater than 33% efficient solar cell using either lattice mismatch or five- or six- junction solar cell technology. Develop a greater than 12% efficient thin-film solar cell on a polymer substrate at least 20 square centimeters in area.			
(U)			
(U) MAJOR THRUST: Develop technologies for advanced space platform structures such as structural controls for vibration suppression, multi-functional structures, deployable large aperture optical arrays, and lightweight	6.488	6.365	5.759

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NUMBER AND TITLE 8809 Spacecraft Vehicle Technologies

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
composite satellite and launch vehicle structures.			
(U) In FY 2005: Performed material characterization of tunable nanotechnology-enhanced lightweight space structures. Fabricated and tested engineering concepts for lightweight structures and precision structural controls for large-aperture space optics. Fabricated and tested low-shock and precision deployment mechanisms for satellite separation and subsystem deployment.			
(U) In FY 2006: Develop advanced mechanisms and guidance strategies for capture and servicing of disabled (non-cooperative) spacecraft. Develop high-temperature, long-soak time thermal re-entry structures.			
(U) In FY 2007: Characterize thermal protection structural performance in reentry environment. Develop autonomy concepts to support defensive/protection actions by spacecraft.			
(U)			
(U) MAJOR THRUST: Develop microsatellite (10-100kg) technologies and integrated microsatellite technology concepts. The innovative microsatellite architectures and advanced satellite bus technologies could enable applications such as space protection, counterspace capabilities, sparse aperture sensing, on-orbit formation flying, inter-satellite communications, distributed processing, and responsive payloads. Note: In FY 2006, efforts move to Project 4846 in this PE and to PE 0603401F, Project 2181.	1.013	0.000	0.000
(U) In FY 2005: Completed evaluation of the technical feasibility and cost-effectiveness of a multi-aperture system to meet future space-based radio frequency intelligence, surveillance and reconnaissance needs.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop flight experiments to address key scientific and technological problems in order to improve the capabilties of existing operational space systems and to enable new transformational space capabilities: Note: In FY 2005, reduction is due to higher Air Force priorities.	9.106	13.583	15.314
(U)			
(U) In FY 2005: Matured space flight experiment design. Developed breadboard hardware for most experimental payloads. Initiated fabrication of core spacecraft flight structure. Closed design trades and advanced all designs to a Preliminary Design Review level. Designed interfaces to launch vehicle and co-manifested spacecraft needed to secure launch manifest. Performed modeling and simulation to quantify benefit to DoD warfighter capability.			
(U) In FY 2006: Complete fabrication of spacecraft structure. Build and test core spacecraft and experimental payloads. Complete mission planning and on-orbit operations guide. Complete spacecraft system Preliminary Design Review to freeze all interfaces. Advance design to level needed for Critical Design Review.			
(U) In FY 2007: Complete Critical design Review for all payloads to freeze all designs and authorize fabrication of all			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **8809 Spacecraft Vehicle Technologies**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	flight hardware. Complete fabrication of integrated spacecraft core including structure and electronics. Initiate delivery of individual experiment payloads and begin assembly, integration, and test with the core spacecraft			
(U)				
(U)	CONGRESSIONAL ADD: Toughened Silicone Substrates for Flexible Solar Cells.	0.976	0.000	0.000
(U)	In FY 2005: Optimized free standing silicone resin substrates for solar cell deposition. Initiated monolithic integration process of Copper-Indium-Gallium-DiSelenide (CIGS) solar cells on silicone resin substrates. Completed initial performance optimization of CIGS solar cells deposited in roll-to-roll production on free standing silicone resin.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Integrated Control for Autonomous Space Systems (ICASS).	1.952	2.464	0.000
(U)	In FY 2005: Advanced the spacecraft system engineering to test and validate the advanced control techniques in a flight experiment. Fabricated breadboard models of spacecraft experimental computer system, networked data acquisition sensors, and networked data interface cards. Tested advanced attitude and dynamic control technologies on breadboard electronics. Closed design trades, initiated mechanical and electrical designs to Preliminary Design Review level.			
(U)	In FY 2006: Conduct Congressionally-directed effort for ICASS.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Elastic Memory Composites (EMC) and Elastic Memory Composites Materials.	1.953	1.479	0.000
(U)	In FY 2005: Improved the reliability of spacecraft deployment mechanisms. Raised the flight readiness of the EMC technology by generating material test data, creating and refining material models and engineering methods for designing EMC components, designing, fabricating, and testing structural validation models of EMC components, and performing a space flight demonstration to build flight heritage.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Elastic Memory Composites.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Converted Silicon Carbide for High Performance Optic Structures.	1.463	4.337	0.000
(U)	In FY 2005: Applied the converted silicon carbide technology from FY 2004 efforts to Air Force systems currently under development. Identified products included the optical elements and support structure for a spaceborne optical system and optical support structures for an airborne directed energy system. Built specimens for integrated testing			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NUMBER AND TITLE 8809 Spacecraft Vehicle Technologies

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	for potential optical space systems.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Converted Silicon Carbide for High Performance Optic Structures.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Lightweight and Novel Structures for Space Program.	3.320	0.000	0.000
(U)	In FY 2005: Reviewed and examined new structures concepts that will enable revolutionary improvements on weight and cost of space structural systems. Identified the most promising concepts for further research and development.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Foldable Articulated Structures for Next Generation Spacecraft.	1.464	0.000	0.000
(U)	In FY 2005: Developed advanced space boom architectures and the mechanisms that enable them to be deployed in space and to enhance the performance of lightweight deployable structures for spacecraft. Verified flight readiness of this technology by performing the following: optimization of design of a family of deployable truss structural system; developed advanced analytical tools and quantitative design methods; performed design, fabrication, testing and qualitative assessment of the system; integration and flight readiness testing of the deployable structure and deployment control system.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Consortium for Autonomous Satellite Systems (CASS).	0.000	1.479	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for CASS.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Deployable Structures Experiment.	0.000	2.267	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Deployable Structures Experiment.			
(U)	In FY 2007: Not Applicable.			
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NUMBER AND TITLE 8809 Spacecraft Vehicle Technologies

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	CONGRESSIONAL ADD: Large Aperture Deployable Structure Systems for Space.	0.000	1.971	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Large Aperture Deployable Structure Systems for Space.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Nano-Reinforced Structures and Advanced Multi-Functional Structures for Space Programs.	0.000	2.366	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Nano-Reinforced Structures and Advanced Multi-Functional Structures for Space Programs.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	31.412	39.897	24.283

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602203F, Aerospace Propulsion.									
(U) PE 0602102F, Materials.									
(U) PE 0603311F, Ballistic Missile Technology.									
(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.

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PE NUMBER: 0602602F
PE TITLE: Conventional Munitions

Exhibit R-2, RDT&E Budget Item Justification

DATE: **February 2006**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602602F Conventional Munitions**

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	50.821	62.061	62.105	58.771	59.318	59.485	59.591	Continuing	TBD
2068	Advanced Guidance Technology	15.912	19.431	17.957	18.204	19.013	19.163	19.252	Continuing	TBD
2502	Ordnance Technology	34.909	42.630	44.148	40.567	40.305	40.322	40.339	Continuing	TBD

Note: In FY 2006, funding increased to support added emphasis on Battlefield Air Operations efforts.

(U) A. Mission Description and Budget Item Justification

This program investigates, develops, and establishes the technical feasibility and military utility of advanced guidance and ordnance technologies for conventional air-launched munitions. The program includes two projects: (1) development of advanced guidance technologies, including seekers, navigation and control, target detection and identification algorithms, and simulation assessments; and (2) development of conventional ordnance technologies, including warheads, fuzes, explosives, munitions integration, and weapon lethality and vulnerability assessments. In FY 2006, Congress added $2.8 million for Advanced Energy Technology for Munitions-Dominator Program and $2.1 million for Falcon Eye. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	51.790	58.058	60.210
(U)	Current PBR/President's Budget	50.821	62.061	62.105
(U)	Total Adjustments	-0.969	4.003	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.039	-0.897	
	Congressional Increases		4.900	
	Reprogrammings			
	SBIR/STTR Transfer	-0.930		
(U)	Significant Program Changes:			

Not Applicable.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602602F Conventional Munitions

PROJECT NUMBER AND TITLE: 2068 Advanced Guidance Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2068 Advanced Guidance Technology	15.912	19.431	17.957	18.204	19.013	19.163	19.252	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project investigates, develops, and evaluates conventional munitions advanced guidance technologies to establish technical feasibility and military utility. This project includes development of advanced guidance including terminal seekers, navigation and control, signal and processing algorithms, and guidance and control simulations. Project payoffs include: adverse-weather and autonomous precision guidance capability; increased number of kills per sortie; increased aerospace vehicle survivability; improved reliability and affordability; and improved survivability and effectiveness of conventional weapons.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Investigate and develop advanced guidance component technologies for adverse weather and autonomous seekers for air-delivered munitions, such as detectors and detector arrays, receiver electronics, signal pre-processing, target recognition, spatial target characteristics, optics, and low-cost beam scanning and shaping technologies. These technologies will enable the development of next generation seekers that will increase a weapon's kill probability, reduce pilot workload, and enhance sortie effectiveness.	6.562	6.441	6.780
(U) In FY 2005: Tested initial laser ranging and detection seeker with the capability to perform 'single-shot' imaging technology. Conducted ground testing a low-cost, synthetic aperture radar seeker to assess future advanced guidance applications. Designed, demonstrated, and tested five optical seeker systems using multiple discriminates to improve performance against obscured or hidden targets.			
(U) In FY 2006: Incorporate and test improved components in laser ranging and detection seekers with goal to provide "single-shot" imaging at useful ranges. Complete testing of a low-cost synthetic aperture radar seeker. Begin fabrication of an optical seeker that uses multi-discriminate signatures to improve targeting against obscured targets. Using ground test data, augment the shape signatures in the automatic target acquisition algorithms to add laser multi-discriminate signatures.			
(U) In FY 2007: Continue improving and testing components in laser ranging seeker to provide "single-shot" imagining. Continue fabrication of an optical seeker that uses multi-discriminate signatures to improve targeting obscured targets. Using ground test data, continue augmenting the shape signatures in the automatic target acquisition algorithms to add laser multi-discriminate signatures.			
(U)			
(U) MAJOR THRUST: Investigate and develop advanced navigation and control technologies for air-delivered munitions to include nonlinear controllers, biomimetic guidance, clutter rejection modules, detection and segmentation modules, and micro-electromechanical gyros. These technologies will allow a more efficient flight path to target, increase stand off ranges, improve resistance to Global Positioning System (GPS) jamming, and	3.441	3.620	3.800

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions	PROJECT NUMBER AND TITLE 2068 Advanced Guidance Technology

(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2005	FY 2006	FY 2007
enhance strike aircraft effectiveness and survivability.			
(U) In FY 2005: Completed developing new design technologies for tactical munitions flight control systems. Completed a modeling and simulation testbed for developing novel ways to enhance weapon system effectiveness through higher levels of integration of guidance, navigation, control, and estimation algorithms. Investigated the neuro-physiology of insects for applications to guidance. Completed investigating concepts for penetrator guidance below the ground surface.			
(U) In FY 2006: Initiate development of navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from Global Positioning System (GPS). Begin developing guidance techniques for small agile vehicles in close proximity to cluttered terrain. Continue investigating the neuro-physiology of insects for application to guidance, particularly engaging moving ground targets. Begin evaluating advanced navigation systems within GPS jamming environments.			
(U) In FY 2007: Continue developing navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Continue developing small agile vehicle guidance to avoid obstacles. Continue applying the neuro-physiology of insects to guide small vehicles to moving targets in an urban-like environment. Continue evaluating navigation systems within GPS jamming environments.			
(U)			
(U) MAJOR THRUST: Investigate and develop advanced optical and digital processors and target detection, classification, and identification algorithms for improved seeker performance to allow greater air-delivered weapon autonomy. Continue developing highly innovative concepts and approaches in guidance and control. These seekers will deny an enemy the ability to hide or camouflage a target, while also decreasing aircrew workload.	1.847	2.900	2.809
(U) In FY 2005: Transitioned initial biomimetic principles developed in basic research for variable resolution sensors that emulate biological or human characteristics for use in advanced seeker components for moving target scenarios. Investigated polarization measurement to differentiate the properties of manmade materials from natural backgrounds. Developed an in-house capability to evaluate contractor-developed optic-flow algorithms.			
(U) In FY 2006: Continue work in biomimetic principles by developing modular models to investigate particular target attributes. Continue investigating polarization techniques to develop model behavior theory. Continue in-house capability to evaluate contractor developed optic-flow algorithms.			
(U) In FY 2007: Continue developing innovative approaches in guidance and control. Continue investigating particular target attributes using biomimetic principles. Continue developing polarization behavior theory models. Continue to evaluate contractor developed optic-flow algorithms.			
(U)			
(U) MAJOR THRUST: Investigate and develop detailed six-degree-of-freedom and hardware-in-the-loop simulations	4.062	4.400	4.568

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions	PROJECT NUMBER AND TITLE 2068 Advanced Guidance Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	including synthetic aperture radar, automatic target recognition, and biomimetic processing. Technologies also include trajectory optimization algorithm and polarization sensing and models to analyze guided munitions and their components that will enable requirement studies, design iteration and evaluation, and experiment risk reduction. These simulations will shorten development time, reduce development costs, and provide more effective munitions.			
(U)	In FY 2005: Conducted analysis efforts and multi-sensor modeling to improve target signature prediction models, expedite development, and reduce the acquisition cycle expense for state-of-the-art seekers. Developed and tested simulation models and reusable end-system simulation tools. Developed a prototype waveform generator, to meet DoD simulator requirements, which use of a commercial synthesizer chip.			
(U)	In FY 2006: Complete development and establish a reusable, simulation architecture consisting of a set of reusable interoperable simulations to evaluate emerging munitions technologies. Complete developing an arbitrary waveform simulation using a commercial synthesizer chip. Improve existing multi-spectral phenomenology models for synthetic scene generation.			
(U)	In FY 2007: Continue refining the set of interoperable simulations, validating the reusable aspect, to evaluate emerging munitions technologies. Improve existing multi-spectral phenomenology models and evaluate in a synthetic scene environment. Develop a set of reusable modeling tools to allow munition simulations to be built from standardized components using standard commercial products.			
(U)				
(U)	CONGRESSIONAL ADD: Falcon Eye.	0.000	2.070	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Falcon Eye.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	15.912	19.431	17.957

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0603601F, Conventional Weapons Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions	PROJECT NUMBER AND TITLE 2068 Advanced Guidance Technology

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602602F Conventional Munitions

PROJECT NUMBER AND TITLE: 2502 Ordnance Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2502 Ordnance Technology	34.909	42.630	44.148	40.567	40.305	40.322	40.339	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project investigates, develops, and evaluates conventional ordnance technologies to establish technical feasibility and military utility to include technologies for advanced conventional weapon dispensers, submunitions, safe and arm devices, fuzes, explosives, warheads, and weapon airframe and carriage technology. The project also assesses the lethality and effectiveness of current and planned conventional weapons technology programs and assesses target vulnerability. The payoffs include: improved storage capability and transportation safety of fully assembled weapons; improved warhead and fuze effectiveness; improved submunition dispensing; low-cost airframe/subsystem components and structures; and reduced aerospace vehicle and weapon drag.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Investigate and develop high fidelity analytical tools, such as computational mechanics models for predicting weapons' effects and assessing target vulnerability. These analysis tools will reduce air-delivered munitions development costs and provide weapons that can generate maximum lethality against a given target class.	4.682	7.024	6.700
(U) In FY 2005: Upgraded and refined basic models illustrating fragmentation effects against various target facilities, including hardened facilities and weapons of mass destruction (WMD). Used campaign analysis tools to compare inventory, budgeted, and conceptual munitions to identify high payoff technologies. Used improved engineering level predictive methods with a simplified finite element model that estimatedthe damage from collapse and instability caused by direct weapon strikes. Developed models to assess the failure of blast doors and other hardened assets in deep underground facilities.			
(U) In FY 2006: Develop code enhancements to computer model for dynamic submunition dispensing of new weapon concepts. Continue developing a simplified finite element model to estimate damage to buildings caused by direct weapon effects. Improve methods for predicting the effects of munition detonations in embedded soil, concrete or rock.			
(U) In FY 2007: Continue modeling damage to buildings caused by direct weapon effects. Continue improving methods for predicting damage caused by detonation of penetrating warheads in a variety of materials. Develop a model to predict the vulnerability of protected assets in deep underground facilities.			
(U)			
(U) MAJOR THRUST: Investigate and develop more efficient, affordable explosives including inert dense metal additives, tungsten-laden explosives, cast and cure high energy composite explosives, and nano-scale metal fuels that provide both higher blast performance and lower ignition sensitivity for air-delivered munitions. These technologies will enable safer, more insensitive to unplanned stimuli, and less expensive explosive fills for inventory and future weapons.	4.034	5.803	6.600

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2005: Developed a highly energetic material with twice the power density of conventional explosives by establishing experimental fragment threshold on-set velocities for a variety of new energetic candidates. Increased the energy output, while maintaining the producibility of cast/cure Plastic Bonded Explosives (PBX), by using advanced energetic materials, plasticizers, and formulation techniques. Conducted an effort to add dense metal powders to PBX to enhance near-field lethality when low collateral damage attributes are required.			
(U)	In FY 2006: Continue developing highly energetic material with twice the power density of conventional by developing and validating new energetics ignition parameters. Demonstrate use of multi-functional material or nano energetic fills. Fabricate cast/cure PBX using advanced materials, plasticizers, and formulation techniques.			
(U)	In FY 2007: Continue developing highly energetic material with twice the power density of conventional explosives by delivering a modeling and simulation capability for enhanced blast materials. Develop energetic liner technology to enhance blast output yet improve the insensitive munition attributes of the weapon system. Demonstrate performance of cast/cure PBX using advanced materials, plasticizers, and formulation techniques.			
(U)				
(U)	MAJOR THRUST: Investigate and develop advanced fuze technologies for air-delivered munitions, such as commercially available micro-mechanical systems, shock-hardened fuzes, low energy detonators, light activated and modular firing systems for advanced single-point initiation, switches, capacitors, power sources, and safe-arming components. These advanced fuze technologies will enhance lethality through precise selection of burst-height at, above, or below the surface to increase weapon safety and tactical performance, while simultaneously decreasing procurement costs and system supportability requirements.	8.315	7.300	7.050
(U)	In FY 2005: Conducted research into the development of a high resolution, electromagnetic countermeasure-hardened, active imaging fuze that calculates warhead burst direction and detonation time. Complete initial design of a miniaturized fuze to effectively control the release of anti-agent for defeating weapons of mass destruction. Developed preliminary miniaturized fuze to provide safe and arm, burst point sensor and low power initiator in a four cubic inch package. Begin developing a wireless communication system to fuze a hard target munition.			
(U)	In FY 2006: Demonstrate a high resolution, electromagnetic countermeasure-hardened, active imaging fuze that calculates warhead burst direction and detonation time. Continue developing a miniaturized fuze to provide safe and arm, burst point sensor and low power initiator in a four cubic inch package. Continue developing a wireless communication system to fuze a hard target munition. Begin to develop waveform agile fuze to defeat smart jamming devices.			
(U)	In FY 2007: Continue developing a miniaturized fuze to provide safe and arm, burst point sensor and low power initiator in a four cubic inch package. Continue developing a wireless communication system to fuze a hard target			

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	munition. Continue to develop a waveform agile fuze to defeat smart jamming devices.			
(U)				
(U)	MAJOR THRUST: Investigate and develop control and carriage technologies for ordnance packages for advanced air-delivered munitions in order to enhance weapon lethality. Examples of these technologies include high-energy formulations, mass-focus fragmentation, and multi-sensor fuzing. These technologies will increase weapon systems effectiveness by contributing to increased weapon load-out on strike aircraft and enhanced sortie effectiveness. Note: In FY 2007, funds are increased to support Battlefield Air Operations efforts.	10.183	11.067	16.350
(U)	In FY 2005: Investigated specific missile subsystem technologies to counter low-observable air targets. Conducted an effort to design and ground test precise time-of-arrival munitions. Identified the critical technologies needed for an advanced next generation, low cost miniature cruise missile. Developed technologies to deny enemy operations through loitering, persistent, low-cost multiple-shot munitions.			
(U)	In FY 2006: Continue research to develop precise time-of-arrival munitions. Continue to identify critical technologies needed for an advanced next generation, low-cost miniature cruise missile. Continue investigating technologies to deny enemy operations through loitering, persistent, low-cost, multiple-shot munitions. Begin investigating application of nanotube-reinforced composites to reduce structural weight of weapons. Develop a miniaturized attack system to communicate target aim point position from behind enemy lines. Develop a covert video capability to collect and transmit data to coordinate attack of enemy targets.			
(U)	In FY 2007: Complete precision time-of-arrival investigation to defeat tunnel blast doors. Continue investigating technologies for miniature cruise missile development. Finish the design studies for loitering, persistent, low-cost multiple-shot munitions. Finish the initial investigation of nanotube reinforced composites to reduce structural weight of weapons. Continue miniaturizing the attack system to communicate target aim point position from behind enemy lines. Continue to develop a covert video capability to collect and transmit data to coordinate attack of enemy targets.			
(U)				
(U)	MAJOR THRUST: Investigate and develop advanced warhead kill mechanisms, such as adaptable warhead, directional control and fragmenting ordnance, and application of reactive metals. The investigation includes characterization of the dynamic response of metals and geologic materials, adjustable yield ordnance packages, and distributed multi-point fire set to enhance air-delivered munition lethality. This enhanced lethality supports the development of smaller munitions with effectiveness similar to current inventory weapons with a corresponding increase in aircraft load-out and sortie effectiveness.	7.695	8.676	7.448
(U)	In FY 2005: Evaluated an ordnance package designed for low collateral damage with high near-field and minimum far-field lethality. Evaluated low collateral damage and multi-mode warheads. Conducted in-house studies to			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions	PROJECT NUMBER AND TITLE 2502 Ordnance Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	improve penetrating warhead case survivability, depth of burial, and trajectory control, with lower case thickness. Evaluted the use of tungsten in high-speed penetrating weapons. Evaluated high energetic materials for adaptable warheads to attack mobile ground targets.			
(U)	In FY 2006: Demonstrate an ordnance package designed for low collateral damage and minimum far-field lethality. Complete in-house effort to improve penetrating warhead case survivability, depth of burial, and trajectory control with lower case thickness. Continue evaluating tungsten for high-speed penetrating weapons. Begin an effort to develop focusing kill mechanisms for dual role, dual range missiles. Begin to investigate micro damage technologies to neutralize electronics with small robotic weapons.			
(U)	In FY 2007: Continue evaluating tungsten for high-speed penetrating weapons. Continue an effort to develop focusing kill mechanisms for dual role, dual range missiles. Continue investigating micro damage technologies to neutralize electronics with small robotic weapons.			
(U)				
(U)	CONGRESSIONAL ADD: Advanced Energy Technology for Munitions Dominator Program.	0.000	2.760	0.000
(U)	In FY 2005: Not Applicable			
(U)	In FY 2006: Develop lightweight fuel cell stack materials to increase system power denisty. Additional goals include development of lightweight recuperators, heat exchanges, and cathode air blowers. Advanced fuel processing catalysts which are capable of logistic fuel operability will also be studied.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	34.909	42.630	44.148

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0603601F, Conventional Weapons Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0602605F
PE TITLE: DIRECTED ENERGY TECHNOLOGY

Exhibit R-2, RDT&E Budget Item Justification	DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602605F DIRECTED ENERGY TECHNOLOGY

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	42.754	44.169	48.422	53.340	54.252	54.761	55.274	Continuing	TBD
4866	Lasers & Imaging Technology	27.673	29.411	23.433	25.193	25.374	25.585	25.809	Continuing	TBD
4867	Advanced Weapons & Survivability Technology	15.081	14.758	15.482	16.440	16.727	16.867	17.008	Continuing	TBD
55SP	Laser and Imaging Space Tech	0.000	0.000	9.507	11.707	12.151	12.309	12.457	0.000	0.000

(U) A. Mission Description and Budget Item Justification

This program covers research in directed energy technologies, primarily lasers and high power microwaves, that are not space unique. In lasers, this includes moderate to high power lasers (solid state and chemical) and associated optical components and techniques. In advanced weapons, this program examines technologies such as narrowband and wideband high power microwave devices and antennas. Both areas also provide vulnerability/lethality assessments of representative systems. Note: In FY 2006, Congress added $2.5 million for Adaptive Optics Lasercom, $2.8 million for Advanced Laser Materials Development, and $1.8 million for Ceramics for Next-Generation Tactical Laser Systems. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	43.594	37.709	42.602
(U)	Current PBR/President's Budget	42.754	44.169	48.422
(U)	Total Adjustments	-0.840	6.460	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.044	-0.640	
	Congressional Increases		7.100	
	Reprogrammings			
	SBIR/STTR Transfer	-0.796		

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics
Under Development.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE: 4866 Lasers & Imaging Technology

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4866	Lasers & Imaging Technology	27.673	29.411	23.433	25.193	25.374	25.585	25.809	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project examines the technical feasibility of moderate to high power lasers and associated optical components required for Air Force missions including long- and short-range weapons, weapon support such as aimpoint selection, and force protection. The technologies developed in this project are not uniquely space-oriented. Technologies applicable for a wide range of vehicles including unmanned combat air vehicles and fighters are being developed. High power solid state and chemical laser devices, optical components, advanced beam control and atmospheric compensation technologies, laser target vulnerability assessment techniques, and advanced optical processes and techniques are developed. Advanced, short-wavelength laser devices for applications such as illuminators and imaging sources for target identification and assessment are developed.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop high power chemical laser technologies for applications such as directed energy weapons, illuminators, and wavelength specific applications.	5.505	6.037	4.458
(U) In FY 2005: Evaluated enhanced, scaled-up versions of the high pressure ejector nozzles incorporating iodine atom generation as appropriate for potential long-range technology insertion into airborne laser applications. Investigated scalability of high performance zero-gravity singlet delta oxygen generator concepts for airborne laser applications. Demonstrated chemical regeneration techniques or single pass singlet delta oxygen generators to reduce the weight of chemicals required for each mission. Demonstrated beam control technology applicable to future airborne lasers.			
(U) In FY 2006: Continue to investigate scalability of high performance zero-gravity singlet delta oxygen generator concepts for airborne laser applications. Demonstrate advanced chemical and electrical singlet oxygen generator technology to help improve current levels of performance. Investigate laser/fiber pumped molecular gas lasers. Develop advanced diagnostics for chemical oxygen iodine laser performance measurements to identify potential enhancements. Begin work on technologies that would increase the range of future high power airborne lasers. Investigate chemical-electrical hybrid laser technologies that offer potential for power scaling and component size and weight reduction.			
(U) In FY 2007: Continue to investigate scaling of high-performance oxygen generator concepts for airborne laser applications. Evaluate iodine injection schemes for oxygen generator. Evaluate and refine advanced chemical laser technologies demonstrated in FY 2006. Pursue scaling chemical-electric hybrid laser technologies that offer potential for power scaling, component size and weight reduction.			
(U)			
(U) MAJOR THRUST: Develop moderate power solid state laser device, beam control, and associated technologies for	4.904	6.790	9.905

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Technology

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
airborne tactical applications, primarily aircraft self-defense with integrated sensors. Technologies being addressed include tailored high-brightness, multi-wavelength compact lasers and advanced beam control techniques to minimize platform vibration, atmospheric jitter, and aero-optical effects.			
(U) In FY 2005: Developed laser component technologies for detecting, identifying, tracking, and defeating electro-optic targets from airborne tactical platforms. Designed and fabricated new laser structures for near-infrared, mid-infrared, and long-wavelength operation. Focused development on power scaling, lower weight, reduced volume, robustness, improved beam quality, and higher efficiency. Developed laser system for optical augmentation to detect optical threats such as sniper scopes. Developed integrated aero-optical wavefront sensor beam control technology for tactical applications. Identified inertial reference unit operating requirements for these laser applications and evaluated existing advanced inertial reference unit technology. Began testing tactical beam control propagation codes.			
(U) In FY 2006: Develop laser component technologies for detecting, identifying, tracking, and defeating electro-optic targets from airborne tactical platforms. Enhance new laser structures for near-infrared, mid-infrared, and long-wavelength operation focusing on power scaling, lower weight, reduced volume, robustness, improved beam quality, and higher efficiency. Develop single- and multi-wavelength packaging and delivery methods. Begin development of system-level solutions to aero-optical issues involving tactical laser applications on airborne platforms. Transition most promising concepts to field testing. Assess laser requirements for destroying detectors in the threat sensors. Analyze the failure modes and other effects when various optics are damaged. Complete integrated aero-optical wavefront sensor development. Complete evaluation of advanced inertial reference unit. Continue testing of tactical beam control propagation codes.			
(U) In FY 2007: Design and develop laser sources for jamming/damaging optical threats. Focus on higher efficiency and higher reliability. Perform ground testing of ultra-short pulse laser sources to evaluate tactical applications. Continue development of system-level solutions to aero-optical issues involving tactical laser applications on airborne platforms. Investigate technologies for tactical platform disturbance mitigation and proceed to subsystem implementation of advanced techniques in a controlled environment. Continue applying latest technologies to tactical laser handheld systems. Begin measurements of active and passive flow control techniques and implement laboratory closed loop and feed forward compensation testing. Conduct laboratory tests to characterize performance of platform disturbance mitigation techniques, such as inertial reference units, develop advanced techniques to improve pointing accuracy by more than a factor of two over current state-of-the-art. Develop selected technologies for transition from laboratory to field testing.			
(U)			
(U) MAJOR THRUST: Perform system assessments to include vulnerability assessments on potential high-energy laser	2.612	1.129	2.334

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Technology

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
targets. Provide critical design data for laser systems to defeat these targets. Develop directed energy concepts and identify issues relating to system architectures, technology readiness, technology trade offs, mission effectiveness, and military utility.			
(U) In FY 2005: Identified additional laser system constraints and performance degradation. Performed vulnerability assessment on ground targets to assess the effectiveness of relay mirror concept. Investigated the integration of technologies into relay mirror concepts. Performed system assessments of laser systems on tactical and bomber platforms. Provided assessment for various technology program decisions in support of a multiple-use electric laser test and integration lab.			
(U) In FY 2006: Perform lethality assessment studies to assess the effectiveness of the various laser concepts in relevant scenarios. Validate vulnerability assessment models by performing mid-scale and full-scale demonstration experiments. Simulate and investigate advanced adaptive optics for uplink beam control. Develop and evaluate two-beam propagation techniques for tracking and illumination of a cruise missile through an airborne relay mirror. Simulate and investigate tactical and bomber defense laser system technologies.			
(U) In FY 2007: Perform additional lethality assessment studies to assess the effectiveness of the various laser concepts in relevant scenarios. Continue mid-scale and full-scale demonstration experiments to validate vulnerability assessment models. Investigate the scalability, affordability, and application of selected relay mirror, bomber defense, and tactical laser systems. Support analysis-of-alternatives with system engineering and military utility assessments for potential directed energy applications. Provide assessment for a multiple-use electric laser test and integration lab. Provide analysis and support for tactical aircraft laser weapons. Develop modeling tools and techniques for analyzing system integration of directed energy systems with potential aircraft platforms.			
(U)			
(U) MAJOR THRUST: Develop scalable high power solid state and electric laser technologies for applicable next-generation laser device applications such as unmanned aerial vehicle designators/imagers and tactical airborne laser weapons.	3.996	6.294	6.345
(U) In FY 2005: Demonstrated 750 watts using novel rotating disk laser technology. Demonstrated megawatt peak power in pulsed fiber laser operating with nanosecond pulses and 10 kilohertz pulse repetition frequency.			
(U) In FY 2006: Investigate and demonstrate alternative laser architectures and gain media. Demonstrate wavelength versatile laser at greater than five watt power levels in the various wavelengths. Refine laser technologies to obtain architectures that are favorable in terms of size, weight, efficiency, affordability, reliability, maintainability, supportability, environmental acceptability (air, land, and maritime), and ruggedness for tactical laser weapon applications.			
(U) In FY 2007: Refine technologies to obtain architectures that are favorable in terms of size, weight, efficiency,			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	affordability, reliability, maintainability, supportability, environmental acceptability (air, land, and maritime), and ruggedness for tactical laser weapon applications. Develop the most promising electric laser technologies for scaling to the weapons class power level. Demonstrate "eyesafe" wavelength electric laser technology for long-range designator and illuminator applications. Perform technical and cost trade off assessments to determine best value for high energy laser testbed.			
(U)				
(U)	MAJOR THRUST: Develop broadly applicable technologies to support future tactical and strategic relay mirrors systems.	0.319	0.546	0.095
(U)	In FY 2005: Investigated potential technologies that could be integrated onto an airborne relay mirror breadboard for further evaluation.			
(U)	In FY 2006: Simulate and investigate advanced adaptive optics for uplink beam control. Develop and evaluate two beam propagation techniques for tracking and illumination of a cruise missile through an airborne relay mirror. Design low-altitude relay mirror field experiments.			
(U)	In FY 2007: Continue investigation of advanced adaptive optics techniques for uplink beam control.			
(U)				
(U)	MAJOR THRUST: Develop optical and beam control technologies to enhance high energy laser beam propagation over long distances in the atmosphere.	2.903	1.617	0.296
(U)	In FY 2005: Developed optical components and complete active tracking experiments. Demonstrated advanced tracking methods and adaptive optics compensation techniques that double the Strehl ratio (peak intensity on target) in stressing atmospheric turbulence. Anchored wave optics propagation code to recent actual beam control performance. Completed concept evaluations using the airborne laser (ABL) wave optics code that includes more detailed models of the ABL beam control system. Completed field testing of advanced tracking algorithms and adaptive optics techniques at the North Oscura Peak propagation range.			
(U)	In FY 2006: Demonstrate high-bandwidth active tracking of uncooperative targets. Begin development of predictive processing techniques to correct atmospheric turbulence-induced track jitter. Experimentally characterize turbulence-induced track jitter over large apertures. Develop and evaluate sensor data, tools, and processes to support an end to end model-based analysis approach for a range of beam control applications.			
(U)	In FY 2007: Investigate active tracking of small/dim targets in conjunction with compensated laser illumination and overall laser system performance characterization. Continue development of predictive processing techniques to correct atmospheric turbulence-induced track jitter. Lay groundwork for field experiments to measure track jitter compensation. Begin developing capability to use sodium beacon adaptive optics to detect small space objects and to image satellites.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	CONGRESSIONAL ADD: Adaptive Optics Lasercom.	2.478	2.464	0.000
(U)	In FY 2005: Developed and tested advanced technologies for a 2.5 gigabit per second air-to-air-to-ground optical communications system on a government test range. Interfaced with other Air Force and Department of Defense agencies to incorporate joint requirements into system performance.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Adaptive Optics Lasercom.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Ultra-Short Pulse Laser technology Development.	4.956	0.000	0.000
(U)	In FY 2005: Developed ultra-short pulse laser technology to obtain high-average, high-peak power. Investigated system engineering issues to package the ultra-short pulse laser technology into a low-weight, low-volume component. Investigated the relevance of ultra-short pulse laser technology for man portable and vehicle portable applications.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Advanced Laser Materials Development.	0.000	2.760	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Advanced Laser Materials Development.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Ceramics for Next-Generation Tactical Laser Systems.	0.000	1.774	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Ceramics for Next-Generation Tactical Laser Systems.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	27.673	29.411	23.433

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0601108F, High Energy									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602605F DIRECTED ENERGY TECHNOLOGY**	PROJECT NUMBER AND TITLE **4866 Lasers & Imaging Technology**

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

Laser Research Initiatives.

(U) PE 0602500F, Multi-Disciplinary Space Technology.

(U) PE 0602890F, High Energy Laser Research.

(U) PE 0603444F, Maui Space Surveillance System.

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.

(U) PE 0603605F, Advanced Weapons Technology.

(U) PE 0603924F, High Energy Laser Advanced Technology Program.

(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE: 4867 Advanced Weapons & Survivability Technology	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4867	Advanced Weapons & Survivability Technology	15.081	14.758	15.482	16.440	16.727	16.867	17.008	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project explores high power microwave (HPM) and other unconventional weapon concepts using innovative technologies. Technologies are developed that support a wide range of Air Force missions such as the potential disruption and degradation of an adversary's electronic infrastructure and military capability. This effect can often be applied covertly with no collateral structural or human damage. Targeted capabilities include local computer and communication systems, as well as large and small air defense and command and control systems. This project also provides for vulnerability assessments of representative U.S. strategic and tactical systems to HPM weapons, HPM weapon technology assessment for specific Air Force missions, and HPM weapon lethality assessments against foreign targets.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Investigate and develop technologies for narrowband and wideband high power microwave (HPM) components to support multiple Air Force applications such as the disruption of electronic systems and subsystems.	7.212	7.058	4.033

(U) In FY 2005: Investigated higher-power compact repetitively operated sources. Improved the electrical efficiency of wideband HPM sources in order to achieve greater range, longer lifetime, and smaller packaging. Conducted pulsed atmospheric breakdown experiments. Conducted explosive generator development experiments to support compact single-shot HPM sources. Conducted a sub-scale (laboratory) repetitively pulsed gigawatt class experiment. Developed conformal phased array antenna for HPM systems. Selected a repetitively pulsed multi-gigawatt technology for HPM breadboard munitions and airborne electronic attack proof-of-concept. Utilized nanotechnology components (nanotubes) to continue development of cathodes and anodes for repetitively pulsed HPM experiments. Developed target identification concept using wideband technology. Developed wideband technology target identification source to demonstrate increased standoff range.

(U) In FY 2006: Develop a compact repetitively pulsed gigawatt-class HPM source. Develop a conformal high power phased array antenna for the compact pulsed HPM source. Develop compact permanent magnets for the compact pulsed gigawatt HPM source. Develop a compact pulse power system to drive the HPM source. Conduct laboratory measurements of the compact pulsed gigawatt HPM demonstration unit. Develop vacuum systems that are compact and can be installed in an airborne platform. Develop compact solid-state wideband source and antenna for target identification. Develop target identification algorithms. Conduct target identification field experiments to determine optimal design.

(U) In FY 2007: Conduct measurements using the compact repetitively pulsed gigawatt-class HPM demonstration unit.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4867 Advanced Weapons & Survivability Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Improve the compact HPM source and conformal antenna that they can be integrated into an airborne platform. Develop a command and control system for the airborne platform HPM unit. Implement nanotechnology to reduce the HPM source weight and size. Conduct field tests of the mesoband system that will characterize the system and demonstrate the effectiveness of the system. Develop an engineering model of a compact wideband target identification system that can be used to conduct laboratory experiments for applications such as targets under trees.			
(U)				
(U)	MAJOR THRUST: Develop and use the ability to assess the effects/lethality of HPM directed energy weapon technologies against representative air and ground systems.	2.268	2.133	4.804
(U)	In FY 2005: Conducted further susceptibility tests to determine relative importance of source parameters to cause desired effects on targets. Proceeded with the refinement of codes to predict probability of effect on target equipment and to guide experiment direction. Refined modeling techniques to incorporate HPM technologies into warfighting/war gaming activities. Proceeded with validation of computer codes' ability to adequately predict the electromagnetic coupling to, and probability of effect on, target equipment within complex structures.			
(U)	In FY 2006: Continue to advance elemental modeling methodology to predict target susceptibility through modeling. Develop advanced descriptions of target functional behavior for insertion into modeling and simulation codes. Continue susceptibility testing of electronic targets.			
(U)	In FY 2007: Predict susceptibilities of relevant current electronic systems based on model and manufacturer and verify accuracy with experiment. Conduct further experiments on the systems and compare predictions with experiments. Adjust models as required. Identify and mitigate platform susceptibility to onboard HPM and associated electromagnetic interference/electromagnetic compatibility considerations for fratricide issues. Refine preliminary battle damage assessment system for "ruggedized" use with HPM sources. Continue susceptibility testing of electronic targets. Apply hardening techniques and technology to identified platforms. Identify and mitigate HPM susceptibility for military systems against both domestic and foreign sources.			
(U)				
(U)	MAJOR THRUST: Develop and apply sophisticated models to enhance the development of HPM and related technology.	0.767	0.747	0.742
(U)	In FY 2005: Investigated/enhanced plasma models and developed the physics algorithms for use with HPM technologies. Developed improved algorithms for higher frequency wideband HPM modeling. Investigated methods for integration of electromagnetic and acoustic software with thermal and electron transport codes for high-fidelity surface simulations. Applied virtual modeling for HPM component technologies.			
(U)	In FY 2006: Validate plasma model on dielectric pulse power interfaces and antenna breakdown. Improve the fidelity of the solution to electromagnetic models by statically refining the numerical grid and by having a boundary			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4867 Advanced Weapons & Survivability Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	conformal solution. Continue integration of electromagnetic codes with thermal and electron transport codes.			
(U)	In FY 2007: Validate integration of electromagnetic codes with thermal and electron transport codes for HPM sources and components. Continue improving the fidelity of the solution to electromagnetic models by automatically refining the numerical grid.			
(U)				
(U)	MAJOR THRUST: Investigate HPM technologies that support offensive and force protection airborne tactical applications made possible by the increased power available on future aircraft.	4.834	4.820	5.903
(U)	In FY 2005: Improved the HPM effects modeling and simulation database so it is warfighter friendly. Upgraded source models to include aircraft concept of operations. Proceeded with source self-mitigation efforts, so as not to interfere with host platform. Investigated source to aircraft command and control efforts. Completed current source component study of plastic-laminate pulse forming lines with integrated Marx pulser. Tested source upgrades and their effect of the aircraft, as well as the command and control interface.			
(U)	In FY 2006: Refine HPM system source code to reflect payload to platform integration issues such as thermal, x-ray, and electrical issues. Examine the status of power conditioning subsystems to determine their applicability to an airborne experiment. Ensure understanding of air breakdown potentials given specific antenna interfaces. Continue refinement of solid state subsystem designs.			
(U)	In FY 2007: Further develop HPM source materials and assess applicability of solid state subsystem designs supporting ruggedized high power airborne. Integrate and test HPM subcomponents to determine applicability to a counter-improvised explosive device mission. Extend HPM system source code to reflect multiple options for high power subsystem components. Refine antenna concepts to meet airborne requirements for counter electronics including addressing issue related to propagation, air breakdown, and radomes. Mature relativistic magnetron technologies. Begin development of full power source test capability which will enable final validation of world record source development. Refine existing beam control/antenna concepts to meet airborne requirements including addressing issue related to propagation, breakdown, and radomes. Research, study and identify technology or data (effects, safety, stabilization, engagement) requirements impacting overall airborne conceptual approach.			
(U)	Total Cost	15.081	14.758	15.482

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602202F, Human Systems									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602605F DIRECTED ENERGY TECHNOLOGY**	PROJECT NUMBER AND TITLE **4867 Advanced Weapons & Survivability Technology**

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

Technology.

(U) PE 0603605F, Advanced Weapons Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE: 55SP Laser and Imaging Space Tech

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
55SP Laser and Imaging Space Tech	0.000	0.000	9.507	11.707	12.151	12.309	12.457	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts will transfer from PE 0602500F, Multidisciplinary Advanced Development Space Technology, Project 5023, Laser and Imaging Space Tech, to this project in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

Develop advanced, long-range optical technologies such as advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large, lightweight optics; and optical coatings that support relay mirror systems. Relay mirror systems can greatly extend the range of high-power laser weapons, as well as low-power imaging systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop advanced, long-range, optical technologies such as advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large, lightweight optics; and optical coatings that support relay mirror systems. Relay mirror systems can greatly extend the range of high-power laser weapons, as well as low-power imaging systems.	0.000	0.000	7.680
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Begin investigations in support of a high-power demonstration to kill a missile through a relay mirror. Complete development of first generation advanced wavefront control device for imaging and beam projection.			
(U)			
(U) MAJOR THRUST: Assess the survivability and vulnerability of satellites to the effects of high-energy laser, as well as other directed energy systems, and update catalogues satellites.	0.000	0.000	1.827
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Develop and apply improved algorithms and hardware for satellite characterization and vulnerability assessment. Continue to update assessment methodology by anchoring modeling tools to empirical data, including results of laser illumination, tracking, and compensated imaging data. Assess the survivability and vulnerability of aerospace systems to the effects of directed energy weapons. Update response databases for continued improvement of predictive avoidance analyses and provide data to U.S. Strategic Command for the performance of Laser Clearinghouse functions.			
(U) Total Cost	0.000	0.000	9.507

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 55SP Laser and Imaging Space Tech

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602500F, Multi-Disciplinary Space Tech.

(U) PE 0603444F, Maui Space Surveillance Systems.

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

(U) PE 0603605F, Advanced Weapons Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0602702F
PE TITLE: Command Control and Communications

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602702F Command Control and Communications

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	84.201	96.714	119.267	118.562	116.126	114.828	110.436	Continuing	TBD
4519	Communications Technology	16.945	24.247	26.884	27.181	27.849	27.225	24.020	Continuing	TBD
4594	Information Technology	27.541	27.178	32.208	31.141	30.663	31.130	31.272	Continuing	TBD
4917	Collaborative Information Tech	5.542	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5581	Command and Control (C2) Technology	34.173	45.289	48.884	42.575	44.623	46.748	45.043	Continuing	TBD
66SP	Space Optical Network Tech	0.000	0.000	11.291	17.665	12.991	9.725	10.101	Continuing	TBD

Note: In FY 2007, Project 6266SP, Space Optical Network Technology, efforts were transferred from PE 0602500F, Multidisciplinary Space Technology, Project 5082, Optical Networking Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This program develops technology for Air Force Command, Control, and Communications (C3). Advances in C3 are required to increase warfighter readiness by providing the right information, at the right time, anywhere in the world. The program has four projects. The Communication Technology project develops assured and secure communications technology. The Information Technology project develops improved and automated capabilities to generate, process, fuse, exploit, interpret, and disseminate timely and accurate information. The Collaborative Information Technology project develops high payoff emerging technologies for the next generation of distributed, collaborative command and control systems. The Command and Control Technology project investigates and develops planning, assessment, and knowledge base technologies to allow the warfighter to plan, assess, execute, monitor, and re-plan on the compressed time scales required for tomorrow's conflicts. Note: In FY 2006, Congress added $1.0 million for Cyber Situational Awareness, $1.0 million for Advanced Collaboration Platform for Net Centric Command and Control and $2.8 million for Decision Support Tools. This program is Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	84.887	93.316	102.163
(U)	Current PBR/President's Budget	84.201	96.714	119.267
(U)	Total Adjustments	-0.686	3.398	
(U)	Congressional Program Reductions		-0.004	
	Congressional Rescissions	-0.065	-1.398	
	Congressional Increases		4.800	
	Reprogrammings			
	SBIR/STTR Transfer	-0.621		
(U)	Significant Program Changes:			

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602702F Command Control and Communications**

Not Applicable.

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE: 4519 Communications Technology	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4519 Communications Technology	16.945	24.247	26.884	27.181	27.849	27.225	24.020	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

The Air Force requires technologies that enable assured, worldwide communications for an agile Expeditionary Aerospace Force (EAF). These communication technologies will provide en route and deployed reachback communications for distributed collaborative command and control. A rapidly deployed EAF requires assured connectivity with reliable, responsive, affordable information exchange via all available communications media. This project provides the technologies for: multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques; lightweight, phased array antennas; and modular, programmable, low-cost software radios. It includes technologies for advanced processors and devices, advanced network protocols and services, intelligent communications management and control, advanced communications algorithms, and enabling communication signal processing techniques.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop assured and survivable information and networking technologies enabling worldwide command, control, and communications operations for the Air Force. Note: FY 2006 and out increase reflects increased emphasis on developing information and networking technologies.	5.924	10.023	12.140

(U) In FY 2005: Continued to develop technologies to improve quality of service and survivability for globally distributed information systems (e.g., Joint Battlespace Infosphere (JBI). Completed the development of assured networking and information systems technologies to improve survivability against critical infrastructure attacks. Completed the development of securely managed enterprise network technology to develop assured network services across multiple network security domains. Continued the development of programmable networking algorithms that enable wide area dynamic creation of advanced information delivery services, independent of the underlying physical infrastructure devices. Initiated the development of capabilities for self-organizing, self-healing, autonomous networking.

(U) In FY 2006: Complete development of technologies to improve quality of service and survivability for globally distributed information systems (e.g., JBI). Complete development of programmable networking algorithms that enable wide area dynamic creation of advanced information delivery services, independent of the underlying physical infrastructure devices. Continue development of capabilities for self-organizing, self-healing, autonomous networking. Initiate development of policy-based network management technologies for real-time network response to changes in information condition (INFOCON) levels. Initiate developments focused on communications/resource network management schemas and sensor exploitation technologies enabling the dynamic integration of communications and sensor management functions for more effective moving target exploitation and fusion. Initiate development of content-based delivery networking (CBDN) technologies for intelligent network delivery and

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 4519 Communications Technology

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
management of end user information.			
(U) In FY 2007: Complete development of capabilities for self-organizing, self-healing, autonomous networking. Continue development of policy-based network management technologies for real-time network response to changes in INFOCON levels. Continue development and test of communications/resource network management schemas and sensor exploitation technologies enabling the dynamic integration of communications and sensor management functions for more effective moving target exploitation and fusion. Continue development of airborne CBDN, synergistic with the Joint Tactical Radio System Wideband Networking Waveform's Network Service Layer, and apply to extremely dynamic infrastructure and network/platform mobility dictated by tactical aircraft.			
(U)			
(U) MAJOR THRUST: Develop improved, higher bandwidth communications and signal processing technologies to provide secure, adaptive, covert, anti-jam, and assured global battlespace connectivity to highly mobile aerospace forces, while reducing the equipment footprint.	4.421	4.484	4.721
(U) In FY 2005: Continued the development of information assurance technologies that improve the robustness of the Global Information Grid in both wireline and wireless networks for air, space, ground, and joint/coalition environments to preclude information systems attacks such as distributed denial of service and degradation of device quality. Continued to develop high performance, adaptable, and reconfigurable wireless devices to implement new waveform technologies for improved robustness, security, and affordability of critical Air Force command and control networks. Continued the development of higher performance video compression and modulation techniques that enable critical objectives for high bandwidth information transmission and exploitation capabilities over wireless channels. Explored the feasibility of the implementation of the above technologies, where applicable, to Joint Tactical Radio System or compatible software radios.			
(U) In FY 2006: Continue development of information assurance technologies that improve the robustness of the Global Information Grid in both wireline and wireless networks for air, space, ground, and joint/coalition environments to preclude information systems attacks such as distributed denial of service and degradation of device quality. Continue development of higher performance, adaptively combined multi-dimensional (space, time, frequency, coding, polarization) transmission techniques that enable high bandwidth information transmission and exploitation capabilities over wireless channels which support command and control, and intelligence, surveillance, and reconnaissance missions, and the use of intelligent munitions. Complete development of higher performance video compression and modulation techniques that enable critical objectives for high bandwidth information transmission and exploitation capabilities over wireless channels. Initiate the design and development of a multi-mode, multi-function, sense-and-adapt air-mobile communications capability to dynamically alter communications methods to support, under fast-changing environments, higher-throughput, anti-jam, low probability of intercept, and/or robust			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602702F Command Control and Communications**	PROJECT NUMBER AND TITLE **4519 Communications Technology**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	[assured] voice, data, and video communications. Perform such design and development within the framework of the Joint Tactical Radio System or compatible software defined radios. Explore/exploit feasible applications of quantum key distribution and cryptography to effect ultra-secure communications for wireline and wireless networks.			
(U)	In FY 2007: Complete first phase development of information assurance technologies that improve the robustness of the Global Information Grid in both wireline and wireless networks for air, space, ground, and joint/coalition environments to preclude information systems attacks. Demonstrate promising higher performance, adaptively combined multi-dimensional (space, time, frequency, coding, polarization) transmission techniques that enable high bandwidth information transmission and exploitation capabilities amongst airborne command and control, and intelligence, surveillance, and reconnaissance platforms and various weapon delivery systems with their smart munitions. Test and demonstrate a multi-mode, multi-function, sense-and-adapt air-mobile communications capability to dynamically alter communications methods under fast-changing environment within the framework of the Joint Tactical Radio System or compatible software defined radios. Develop and test promising quantum key distribution and cryptography technologies to effect ultra-secure communications for wired and wireless networks. Perform transition planning.			
(U)				
(U)	MAJOR THRUST: Develop critical information transmission technologies to permit the seamless integration of aerospace weapon systems' C2, intelligence, surveillance, and reconnaissance data/information. Note: Effort transferred from Project 4917 in FY 2006.	0.000	1.796	2.135
(U)	In FY2005: Not Applicable.			
(U)	In FY2006: Initiate exploration of techniques for tunable, high power radio frequency filtering to reduce overall radio frequency component equipment size, weight, and signal losses. Continue development, test, and assessment of exploratory radio frequency and optical information transfer technologies.			
(U)	In FY2007: Continue to explore multiple technologies/techniques for tunable, high power radio frequency filtering to reduce overall radio frequency component equipment size, weight, and signal losses. Continue development, test, and assessment of exploratory radio frequency and optical information transfer technologies.			
(U)				
(U)	MAJOR THRUST/CONGESSIONAL ADD: Develop cyber operations technologies for enabling worldwide command, control, communications and intelligence. This effort includes Congressional Add funding of $1.0 million in FY 2006.	6.600	7.944	7.888
(U)	In FY 2005: Continued to develop automated capabilities for damage assessment and recovery techniques. Completed the development of network forensics. Continued the development of data mining tools for detecting adversary information warfare attacks and provide early warning notification. Continued to develop detection and			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 4519 Communications Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	eradication techniques for malicious code. Continued the development of active response technologies. Continued the development of advanced correlation fusion techniques for defensive course of action analysis. Continued the development of intrusion detection techniques for wireless networks. Continued the development of tools and techniques to protect command, control, communications, intelligence, and information systems, and allow for integration of coalition information elements.			
(U)	In FY 2006: Continue development of intrusion detection techniques for wireless networks. Continue to develop automated capabilities for damage assessment and recovery. Continue to develop techniques for defining defensive courses-of-action to counter adversary information warfare attacks. Continue to develop defensive techniques for wireless, mobile and embedded systems. Continue to develop detection and eradication techniques for malicious code. Continue development of active response and computer network attack (CNA) technologies. Continue development of advanced correlation fusion techniques for defensive course of action analysis. Initiate work addressing self-healing systems. Conduct Congressionally directed efforts for Cyber Situational Awareness.			
(U)	In FY 2007: Complete development of intrusion detection techniques for wireless networks. Continue to develop automated capabilities for damage assessment and recovery. Continue to develop techniques for defining defensive courses-of-action to counter adversary information warfare attacks. Continue to develop defensive techniques for wireless, mobile and embedded systems. Continue to develop detection and eradication techniques for malicious code. Continue development of active response and CNA technologies. Continue development of advanced correlation fusion techniques for defensive course of action analysis. Continue efforts in self-healing systems.			
(U)	Total Cost	16.945	24.247	26.884

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0603789F, C3I Advanced Development.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE: 4594 Information Technology	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4594 Information Technology	27.541	27.178	32.208	31.141	30.663	31.130	31.272	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

The Air Force requires technologies that improve and automate their capability to generate, process, manage, fuse, exploit, interpret, and disseminate timely and accurate information. This project improves global awareness at all levels, enabling warfighters to understand relevant military situations on a consistent basis with the timeliness and precision needed to accomplish their missions. Global awareness is achieved by exploiting information provided by the Air Force, other government agencies, and open source information. The information is fused to support the dynamic planning and execution cycle via the global information enterprise. Knowledge, information, and data are all archived in the global information base for continued use and historical analysis. The information technologies required to achieve this capability are developed under this project in an affordable manner and include appropriate access mechanisms for our coalition partners. This project develops high-payoff embedded information systems technologies for the next generation of distributed information integration architectures to enable global information dominance and air and space superiority. The embedded information systems technologies provide affordable, innovative, secure, net-enabled embedded information systems to the warfighter.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop innovative multi-sensor collaborative fusion technologies in a fully distributed air and space environment.	6.703	6.368	7.666

(U) In FY 2005: Evaluated fusion techniques to determine optimal algorithms based upon data available that support the analysis of a new emerging information era. Continued to develop optimized multi-source fusion techniques for positive identification and continuous tracking of militarily significant vehicles in the battlespace. Continued the development and evaluation of fusion technologies for enemy threat prediction based on the use of multi-source fusion.

(U) In FY 2006: Continue to develop and evaluate fusion techniques for optimal fusion management. Test and analyze vehicle motion models for variable state multiple algorithm to associate the current location of vehicle with a future state. Enhance multi-source fusion techniques for probabilistic identification and continuous tracking of military significant threats in the battlespace. Evaluate evidence accrual and data mining techniques for improved fusion performance. Develop new measures of performance for higher levels of fusion in analyzing situational assessment and process refinement.

(U) In FY 2007: Evaluate fusion management and advance the state-of-the-art in track-to-track fusion techniques. Continue the process of probabilistic identification though the use of multi-source fusion. Increase probabilistic confidence through the inclusion of higher-level fusion techniques in the situational assessment and process refinement area. Develop techniques to dynamically update advanced reasoning fusion engines to adapt to changing

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 4594 Information Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	threat conditions. Develop intelligence, surveillance, and reconnaissance management techniques that optimize the fusion process for identification and continuous tracking of military significant threats. Evaluate network centric approaches to provide distributed fusion techniques to the warfighter.			
(U)				
(U)	MAJOR THRUST: Develop higher-level fusion and the enabling information/knowledge base technologies to achieve situational awareness at all command levels for the dynamic planning and execution process.	5.604	5.703	6.765
(U)	In FY 2005: Continued the development of intermediate information extraction techniques to decrease analysis time for decision-making and enabling the ability to populate knowledge base systems. Continued the development of data mining techniques for self-organizing data repositories and content-based extraction to support identification of potential events in the world. Continued the development of web-based search techniques, data filtering techniques, and information aggregation methods to take advantage of the explosion of available data on the Web required for rapid situational understanding. Developed new techniques addressing key entity extraction technology gaps, to improve the accuracy of Air Force and joint systems that exploit information from unstructured text for situation analysis.			
(U)	In FY 2006: Complete development of intermediate information extraction techniques to decrease analysis time for decision-making and enabling the ability to populate knowledge base systems. Complete development of techniques addressing key entity extraction technology gaps, to improve the accuracy of Air Force and joint systems that exploit information from unstructured text for situation analysis. Continue development of interactive contextual reasoning with inference techniques for self-organizing data repositories, and content-based extraction to support identification of potential events in the world. Continue enhancement of web-based search techniques, data filtering techniques, and information aggregation methods to take advantage of the explosion of available open source data on the Web required for rapid situational understanding. Develop inferencing techniques for reasoning about the situation and predict enemy intent and threat possibility.			
(U)	In FY 2007: Enhance techniques for interactive contextual reasoning with inference techniques for self-organizing data repositories and content-based extraction to support identification of potential events in the world. Continue enhancement of web-based search techniques, data filtering techniques, and information aggregation methods to take advantage of the explosion of available open source data on the Web required for rapid situational understanding. Continue developing inferencing techniques for reasoning about the situation and for predicting enemy intent and threat possibility.			
(U)				
(U)	MAJOR THRUST: Develop automatic and dynamically reconfigurable, affordable, scalable, distributed petaflop processing technologies for real-time C2 global information systems.	3.903	4.041	4.785

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 4594 Information Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2005: Demonstrated an architecture for rapid extraction of information from globally distributed knowledge bases. Demonstrated an architecture to support real-time requirements for dominant battlespace awareness. Continued the study of next generation information technologies (e.g., quantum computing and bio-molecular computing) for C2 systems.			
(U)	In FY 2006: Complete architecture for support of real-time requirements for dominant battlespace awareness. Complete study results of next generation information technologies for C2 systems. Continue evaluation of architectural features for cognitive information processing. Initiate algorithm development for next generation information technologies for C2 systems. Initiate architectural development for cognitive information processing. Develop and characterize high performance computers for quantum computing applications.			
(U)	In FY 2007: Complete evaluation of architectural features for cognitive information processing. Continue algorithm development for next generation information technologies for C2 systems. Continue architectural development for cognitive information processing. Continue development and characterization of high performance computers for quantum computing applications. Initiate development and characterization of the next generation of high performance computers.			
(U)				
(U)	MAJOR THRUST: Develop modeling and simulation technologies for the next generation of planning, execution, and assessment environments.	1.986	2.426	2.781
(U)	In FY 2005: Continued to develop modeling and simulation technologies to support next generation planning execution and assessment environments. Developed adversarial behavior models and modeling techniques for course of action assessment and prediction. Prototyped and demonstrated decision support technologies and the theoretical foundation to support high-profile system concepts such as Air Force Concepts of Operations.			
(U)	In FY 2006: Continue to develop advanced modeling and simulation technologies to support next generation planning execution and assessment environments. Continue development of adversarial behavior models and modeling techniques for dynamic course of action assessment and prediction. Initiate investigation of techniques for integrated interaction and assessment of friendly versus enemy courses of action. Develop simulation techniques for dynamic situation assessment and prediction.			
(U)	In FY 2007: Demonstrate advanced modeling and simulation technologies to support next generation planning execution and assessment environments. Demonstrate adversarial behavior models and modeling techniques for course of action assessment and prediction. Conduct concept demonstrations of integrated interaction and assessment of friendly versus enemy courses of action. Demonstrate a prototypical dynamic situation assessment and prediction system. Investigate advanced concepts to provide approaches for a modeling toolset that enables the warfighter to build composable simulations.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 4594 Information Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	MAJOR THRUST: Develop real-time embedded information system technologies for complex, time-critical, embedded systems to enable affordable design and development of state-of-the-art hardware and software, innovatively incorporate new capabilities, reactively adapt to multiple missions and changing environments, verify, validate, and assure functionality and integrity, and facilitate rapid insertion to support real-time, collaborative operations within a net-centric enterprise. Note: Effort transfered from Project 4917 in FY 2006.	0.000	1.978	2.257
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Continue development of dynamically reconfigurable aerospace systems using adaptive computing techniques to support image/video processing and data compression. Continue to develop adaptive embedded computing technologies to support enhanced interoperability and information exchange between tactical C2 platforms to support network centric operations, based on Real-Time Java and reconfigurable computing. Continue to develop processes, methods, and techniques to provide assured performance, integrity, and security of real-time embedded information systems. Continue to develop algorithms, methods, and processes to support real-time, adaptive resource management of system resources across multiple tactical platforms. Continue to develop multi-level secure middleware for real-time embedded system architectures. Continue development of methods of computation and computing processes using biologically-inspired and biologically-based computation for embedded systems application. Initiate development of power-aware, polymorphic aerospace systems for mission-aware computing.			
(U)	In FY 2007: Continue development of dynamically reconfigurable aerospace systems using adaptive computing techniques to support image/video processing and data compression. Complete program to develop adaptive embedded computing technologies to support enhanced interoperability and information exchange between tactical C2 platforms to support network centric operations, based on Real-Time Java and reconfigurable computing. Continue to develop processes, methods, and techniques to provide assured performance, integrity, and security of real-time embedded information systems. Continue to develop algorithms, methods, and processes to support real-time, adaptive resource management of system resources across multiple tactical platforms. Continue to develop multi-level secure middleware for real-time embedded system architectures. Continue development of methods of computation and computing processes using biologically-inspired and biologically-based computation for embedded systems application. Continue development of power-aware, polymorphic aerospace systems for mission-aware computing.			
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop digital information exploitation technologies for electronic communications and special signals intelligence, imagery, and measurement signatures to increase accuracy, correlation, and timeliness of the information value to the decision maker. Note: This effort includes Congressional	9.345	6.662	7.954

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 4594 Information Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	Add funding of $2.5 million in FY 2005.			
(U)	In FY 2005: Continued the development of advanced multi-sensor and automated analyst tools for exploiting measurement and signature intelligence, commercial sources and hyperspectral imagery, on-board video processing, new digital electronic signals, moving target indicator, and speech intelligence products to feed an information fusion process in support of the decision maker. Continued the development of techniques in steganography, steganalysis, watermarking, and digital data forensics for imagery, video, and speech information protection and authentication, intelligence exploitation, and analysts' tool aids. Initiated the investigation of new techniques to improve open systems techniques for multi-sensor exploitation for enhanced indications and warning and situational awareness.			
(U)	In FY 2006: Continue to develop tools to increase the production capability of the intelligence analyst. Continue development of techniques in steganography, steganalysis, watermarking, and digital data forensics for imagery, video, and speech information protection and authentication, intelligence exploitation, and analysts' tool aids. Continue the development of tools to detect, track, and analyze document and file tampering through the use of steganography, steganalysis, and digital watermarking.			
(U)	In FY 2007: Complete first phase development of techniques in steganography, steganalysis, watermarking, and digital data forensics for imagery, video, and speech information protection and authentication, and intelligence exploitation. Continue the development of the multi- intelligence toolsets for the processing, exploitation and dissemination of actionable intelligence.			
(U)	Total Cost	27.541	27.178	32.208

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0603789F, C3I Advanced Development.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602702F Command Control and Communications**

PROJECT NUMBER AND TITLE: **4917 Collaborative Information Tech**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4917 Collaborative Information Tech	5.542	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

To implement the Global Strike Task Force and other task force concepts, the Air Force requires a distributed, collaborative C2 system, allowing the majority of the C2 center to remain in the continental United States, while only a small command element is deployed forward. This project accomplishes the initial exploration of high payoff emerging technologies for the next generation of distributed collaborative C2 systems. This program develops technologies for platform connectivity, distributed collaboration, and embedded information systems. Platform connectivity technologies focus on advanced modulation waveforms for bandwidth efficiency, assured aerospace platform connectivity for C2, and conceptual design approaches for seamless integration of aerospace weapon systems into the information grid. Distributed collaboration technologies advance collaboration science, virtual environments, and predictive simulation tools to facilitate the development and fielding of next generation operational collaborative decision support systems. Embedded information systems technologies explore high payoff technologies for the next generation of distributed information integration architectures, which will provide cross disciplinary products/capability to a decision maker when, where, and how it is needed. It also provides embedded information system technologies for affordable and adaptable design and development of complex C2 systems, facilitated by an open system architecture approach.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop critical information transmission technologies to permit the seamless integration of aerospace weapon systems' C2, intelligence, surveillance, and reconnaissance data/information. Note: In FY 2006, this effort moves to Project 4519 in this PE.	1.977	0.000	0.000
(U) In FY 2005: Continued the development of assured communications technology, leveraging commercial infrastructure for positive C2 of aerospace assets in commercial airspace. Completed the design and development of secure, wide-band wireless miniaturized transceiver information transfer technology for assured communications between munitions and aircraft. Developed, tested, and assessed exploratory information transfer technologies.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop processes, methods, and techniques to provide assured performance, integrity, and security of real-time embedded information systems. Note: In FY 2006, this effort moves to Project 4594 in this PE.	1.480	0.000	0.000
(U) In FY 2005: Continued the development of dynamically reconfigurable aerospace systems using adaptive computing techniques. Continued to develop algorithms, methods, and processes to support real-time, adaptive resource management of system resources across multiple tactical platforms. Developed methods and processes for implementation of Java and Real-Time Java Virtual Machines using adaptive computing techniques.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 4917 Collaborative Information Tech

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop advanced information technologies for collaborative decision support, knowledge management, and rapid adaptation/re-allocation of assets in response to the continually changing threat environment. Note: In FY 2006, this effort moves to Project 5581 in this PE.	2.085	0.000	0.000
(U)	In FY 2005: Continued the development of techniques to perform collaborative, capability-based planning required by the seven Air Force Concepts of Operation. Continued the development of distributed collaborative environment technology for effects-based operations and predictive battlespace awareness. Completed work to develop technology to support a sensor-to-shooter scenario stressing time-critical target requirement, which will deny the enemy sanctuary of time.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	Total Cost	5.542	0.000	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0603789F, C3I Advanced Development.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE: 5581 Command and Control (C2) Technology	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5581	Command and Control (C2) Technology	34.173	45.289	48.884	42.575	44.623	46.748	45.043	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

The Air Force requires C2 technologies that will provide the next generation of weapon systems with improved processing and presentation of information for real-time, distributed battle management. Technologies in this project must be capable of taking advantage of future net-centric environments including new structured and ad hoc processes in response to rapidly changing warfare challenges. Technologies being developed will increase capability, quality, and information interoperability, while reducing the cost of C2 systems and infrastructure. Technology development in this project focuses on planning and assessing techniques knowledge bases, distributed information systems, and information management and distribution services. Advances in planning and assessment technologies will vastly improve the military decision making process within C2 systems. Advances in the ability to detect, classify, identify, and track objects and events will improve the understanding and prediction of enemy intentions, allowing the development of various courses of action to counter their intentions. Advances in the development of very large comprehensive knowledge bases to rapidly formulate and create new knowledge are needed by the Expeditionary Aerospace Force. Advances in distributed intelligent information systems will allow automatic rapid reconfiguration of C2 centers to respond to varying crisis levels, as required, by a Net-Centric Aerospace Force. Advances in robust information management and dissemination technologies will ensure the delivery of high-quality, timely, secure information to the warfighter.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Investigate and develop technologies for the rapid development and application of next generation knowledge bases for aerospace C2 systems.	7.258	6.816	7.738

(U) In FY 2005: Investigated and developed technologies for the rapid development and application of next generation knowledge bases for aerospace C2 systems. Continued to develop tools that will automate the intelligent extraction, correlation, and classification of link patterns for discovering relevant linkages between entities. Continued the development of ultra-large all-source information repositories and associated privacy protection technologies.

(U) In FY 2006: Demonstrate tools that will automate the intelligent extraction, correlation, and classification of link patterns for discovering relevant linkages between entities. Continue to develop technologies for the rapid development and application of next generation knowledge bases for aerospace C2 systems. Initiate development of foundations, technology, and tools to enable effective, practical automated reasoning of the scale and complexity required for computers to perform complex tasks in the real world requiring intelligence. Initiate development of cognitive architectures for self-aware, learning agents.

(U) In FY 2007: Complete development of technologies for the rapid development and application of next generation knowledge bases for aerospace C2 systems. Continue to develop foundations, technology, and tools to enable

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 5581 Command and Control (C2) Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	effective, practical automated reasoning of the scale and complexity required for computers to perform complex tasks in the real world requiring intelligence. Investigate and develop specialized cognitive architectures using self-aware, learning agents that can generate well-focused knowledge bases for automated intelligent extraction, correlation, and classification of link patterns for discovering relevant linkages between entities.			
(U)				
(U)	MAJOR THRUST: Investigate, analyze, and develop technologies for automatic rapid reconfiguration of distributed intelligent information systems to varying crisis levels faced by the Expeditionary Aerospace Force. Note: FY 2006 and out increase reflects increased emphasis on developing automatically reconfigurable information system technologies.	8.085	12.772	13.732
(U)	In FY 2005: Continued to develop dynamic and adaptable interface technology that allows commanders to create a mission-tailored view of the configuration and status of the currently executing Air Operations Center (AOC) C2 process. Continued to develop advanced interactive displays suitable for deployment with C2 applications and command centers. Initiated the development of advanced techniques and AOC-based applications for information visualization for use in conjunction with multiple, heterogeneous data sets. Continued to develop technologies to improve the fidelity, accuracy, and interconnection of computer-based wargames used to prepare contingency plans and response strategies.			
(U)	In FY 2006: Continue to develop dynamic and adaptable interface technology that allows commanders to create a mission-tailored view of the configuration and status of the currently executing AOC C2 process. Continue to develop advanced interactive displays suitable for deployment in harsh environments with C2 applications and command centers. Continue development of advanced techniques and AOC-based applications for information visualization for use in conjunction with multiple, heterogeneous data sets. Continue to develop technologies to improve the fidelity, accuracy, and interconnection of computer-based wargames used to prepare contingency plans and response strategies. Initiate development of technologies for a holistic tool set that commanders can use to probe, study, analyze, visualize, reason, and predict activities in the battlespace.			
(U)	In FY 2007: Continue to develop dynamic and adaptable interface technology that allows commanders to create a mission-tailored view of the configuration and status of the currently executing AOC C2 process. Continue to develop advanced interactive displays suitable for rapid deployment in harsh environments with C2 applications and command centers. Continue development of advanced techniques and AOC-based applications for information visualization for use in conjunction with multiple, heterogeneous data sets. Continue to develop technologies to improve the fidelity, accuracy, and interconnection of computer-based wargames used to prepare contingency plans and response strategies. Continue development of technologies for a holistic tool set that commanders can use to probe, study, analyze, visualize, reason, and predict activities in the battlespace.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
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(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)			
(U) MAJOR THRUST: Investigate and develop technologies to securely share information via publish, subscribe, and query with coalition partners as part of the overall Global Information Grid approach. Sharing of information is in part a function of secure sharing, but is also a function of the managing of the information in assessing the trustworthiness of the information and its markup. Note: This effort was broken out from the next Major Thrust below due to the increased emphasis on C2 in a coalition environment.	5.190	6.446	9.354
(U) In FY 2005: Initiated the investigation and development of technologies to dynamically filter and fuse information and produce customized coalition information products. Started the development of techniques and tools that will ensure availability, integrity, and survivability of information within a coalition net-centric environment. Initiated the development of technology approaches that will rapidly incorporate coalition force structure units into an operational Community of Interest (COI) Infosphere.			
(U) In FY 2006: Complete investigation of technologies to dynamically filter and fuse information and produce customized coalition information products. Continue development of technology approaches to rapidly assimilate appropriate coalition partners into appropriate COI Infospheres. Extend cross-domain information sharing research and development to include collaborative monitoring and management of multi-national enterprise resources such as firewalls/guards/routers, application servers, intrusion detection systems, etc. Investigate the ability to perform and enforce role-based access control to these COI Infospheres. Focus research on multi-domain event correlation from a centralized perspective (e.g., guarding services enabled, multi-level security repository) in order to establish a composite picture of resource status with the ability to centrally react to that status. Continue development of techniques and tools that will ensure availability, integrity, and survivability of information within a coalition net-centric environment. Initiate development of publish/subscribe technologies for application to a CBDN system for intelligent network management of user information.			
(U) In FY 2007: Complete development of techniques and tools that will ensure availability, integrity, and survivability of information within a coalition net-centric environment. Complete development of technology approaches to rapidly assimilate appropriate coalition partners into appropriate COI Infospheres. Complete investigation on performing and enforcing role-based access control to these COI Infospheres. Continue cross-domain information sharing research and development to include collaborative monitoring and management of multi-national enterprise resources. Continue development of techniques and tools that will ensure availability, integrity, and survivability of information within a coalition net-centric environment. Investigate technologies, which can determine the pedigree of information in a coalition environment and assess the trustworthiness of the marked up information to be shared throughout the coalition. Investigate and prototype the application of information fusion and information management technologies such as fuselets to extend composite views of events across a multi-domain enterprise into			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 5581 Command and Control (C2) Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	fused events. Continue development of publish/subscribe technologies for application to a CBDN system for intelligent network management of user information.			
(U)				
(U)	MAJOR THRUST: Develop next generation monitoring, planning, execution, and assessment technologies and tools enabling distributed aerospace commanders to efficiently and collaboratively develop effects based campaigns.	9.801	9.516	9.944
(U)	In FY 2005: Continued to develop technologies to dynamically and rapidly assess the battlespace, and provide near-real-time C2 of available resources to execute the required missions incorporating developments in decision support science. Completed the development of tools to visualize the probability of success of qualitatively different courses of action. Continued to develop intelligent information systems capable of supporting joint/coalition C2 for various missions. Continued to develop and assess active template and semantic ontology technologies for use in C2 applications. Continued to develop tools to increase situational awareness through intelligent information push and pull in dynamic environments. Initiated the investigation of intelligent information processing techniques to enhance the C2 decision-making process, such as family of web service concepts; secure, shareable object spaces; legacy bridges; component-based architectures; information presentation components; and incorporation of Network Centric Warfare Service concepts. Investigated the application of decision support sciences to C2 activities within a Coalition AOC.			
(U)	In FY 2006: Continue to develop technologies to dynamically and rapidly assess the battlespace with a special emphasis on effects based assessment. Continue to investigate application of decision support sciences to C2 activities within a Coalition AOC. Extend Course of Action analysis capability to allow collaboration between geographically remote locations. Continue to develop intelligent information systems capable of supporting joint/coalition C2 for various missions. Continue to develop and apply semantic ontology technologies for use in C2 applications, such as effects-based planning and dynamic tasking. Continue to develop tools to increase situational awareness through intelligent information push and pull in dynamic environments. Continue investigation of intelligent information processing techniques to enhance the C2 decision-making process, such as family of web service concepts; secure, shareable object spaces; legacy bridges; component-based architectures; information presentation components; and incorporation of Network Centric Warfare Service concepts. Prototype these techniques and demonstrate feasibility and usefulness. Explore the application of system of systems and federation of systems engineering principles to enable joint C2 capabilities.			
(U)	In FY 2007: Complete development of next generation of monitoring, planning, execution, and assessment technologies and tools enabling aerospace commanders to efficiently and collaboratively develop effects-based campaigns. Complete development of technologies to dynamically and rapidly assess the battlespace, and provide near-real-time command of manned and unmanned forces to execute the required missions. Complete the			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 5581 Command and Control (C2) Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	incorporation of decision support science into C2 tools. Complete Course of Action analysis capability to allow collaboration between geographically remote locations. Continue to investigate application of decision support sciences and advanced decision-making concepts to C2 activities within a Coalition AOC. Continue to develop intelligent information systems capable of supporting joint/coalition C2 for various missions in a dynamically changing environment. Continue to develop tools to increase situational awareness through intelligent information processing. Continue the application of system of systems and federation of systems engineering in the creation of joint C2 capabilities. Explore the application of intelligent software agents as virtual battle staff members to enhance various C2 processes. Develop and demonstrate an effects-based dynamic tasking process enabled by dynamically accessible data and information services.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop distributed collaboration technologies, advance collaboration science, virtual environments, and predictive simulation tools to facilitate the development and fielding of next generation operational collaborative decision support systems. Note: This effort was performed in Project 4917 prior to FY 2006. This effort includes Congressional Add funding of $3.8 million in FY 2006.	0.000	5.771	2.177
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Continue development of advanced information technologies for collaborative decision-making and knowledge management in support of capability-based planning, Air Force concepts of operations, and next generation planning, execution, and assessment environments. Continue development of distributed collaborative environment technology for operations other then war and similar applications. Conduct Congressionally-directed efforts for an Advanced Collaborative Platform for Netcentric Command and Control, and for Decision Support Tools.			
(U)	In FY 2007: Continue development of advanced information technologies for collaborative decision-making and knowledge management in support of capability-based planning and next generation planning, execution, and assessment environments. Prototype distributed collaborative environment technologies for advanced decision support for high-profile system concepts, such as the Global Strike Concept of Operations and operations other then war.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Investigate and develop technologies to implement flexible, high performance, secure, scalable, and survivable information management and dissemination services to enable a Global Information Grid-based COI Infosphere. Note: This effort includes Congressional Add funding of $1.0 million in FY 2005.	3.839	3.968	5.939
(U)	In FY 2005: Completed development of techniques and tools for integrating legacy client-server C2 systems into a			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 5581 Command and Control (C2) Technology

(U) B. Accomplishments/Planned Program ($ in Millions) — FY 2005 | FY 2006 | FY 2007

publish, subscribe, and query COI infosphere. Continued to investigate and develop publish, subscribe, and query technologies enabling a secure infosphere that can support thousands of C2 and intelligence, surveillance, and reconnaissance clients at various levels of security classification, and can operate within a coalition warfighting environment. Investigated new advanced publish, subscribe, and query technologies for the information management services, which provide higher levels of performance, security, and scalability to meet Air Force net-centric requirements. Investigated techniques to optimize these publish, subscribe, and query mechanisms to be used within bandwidth limited environments. Investigated automated methods of tailoring the user perspective of the COI Infosphere to reduce information overload and increase information awareness and utilization. Investigated the interoperability of various COI Infospheres (e.g., Combat Support, Intel, Business) with respect to the management and sharing of information across them. Investigated the ability to monitor, obtain feedback, and assert control over the COI Infosphere.

(U) In FY 2006: Continue to investigate and develop publish, subscribe, and query technologies enabling a secure infosphere that can support thousands of C2 and intelligence, surveillance, and reconnaissance clients at various levels of security classification, and can operate within a coalition warfighting environment. Complete investigation of new advanced publish, subscribe, and query technologies for the Information Management services, which provide higher levels of performance, security, and scalability to meet Air Force net-centric requirements. Complete investigation of techniques to optimize these publish, subscribe, and query mechanisms to be used within bandwidth-limited environments. Continue to investigate automated methods of tailoring the user perspective of the COI Infosphere to reduce information overload and increase information awareness and utilization. Complete investigation of the interoperability of various COI Infospheres (e.g., Combat Support, Intel, Business) with respect to the management and sharing of information across them. Develop high payoff publish, subscribe and query laboratory prototypes which provide higher levels of performance, security, and scalability capable of exceeding commercial products and support Air Force Net-centric environment needs. Continue to investigate automated methods of tailoring the user perspective of the COI Infosphere to reduce information overload and increase information awareness and utilization. Focus on automated composition of tailoring entities, and runtime environments. Continue to investigate methods and techniques for dynamically evolving the net-centric environment so as to avoid system crashes or latency as new information sources arrive or depart the environment. Focus is on representation of real-time performance guarantees and negotiation for various levels of service as would be required in tactical aircraft. Investigate and assess the use of semantic markup and semantic web languages as part of the COI Infosphere. Initiate the investigation of technology and approaches to prioritizing information in a COI Infosphere so as to effectively utilize communication and computing resources. Continue to develop technology and techniques to monitor, obtain feedback, and assert control over the COI Infosphere.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 5581 Command and Control (C2) Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Complete investigation in the use of semantic markup and semantic web languages as part of the COI Infosphere. Complete investigation of technology and approaches to prioritizing information in a COI Infosphere so as to effectively utilize communication and computing resources. Continue to develop high-payoff publish, subscribe, and query laboratory prototypes, which provide higher levels of performance, security, and scalability capable of exceeding commercial products and support Air Force net-centric environment needs. Continue to investigate automated methods of tailoring the user perspective of the COI Infosphere to reduce information overload and increase information awareness and utilization. Continue to develop technology and techniques to monitor, obtain feedback, and assert control over the COI Infosphere. Investigate the security policy enforcement between COI Infospheres at various levels of security classification. Continue to investigate methods and techniques for dynamically evolving the netcentric environment so as to avoid system crashes or latency as new information sources arrive or depart the environment.			
(U)	Total Cost	34.173	45.289	48.884

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0603617F, C3 Applications.									
(U) PE 0303401F, Communications-Computer Systems (C-CS) Security RDT&E.									
(U) PE 0603789F, C3I Advanced Development.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE: 66SP Space Optical Network Tech

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
66SP	Space Optical Network Tech	0.000	0.000	11.291	17.665	12.991	9.725	10.101	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, Project 6266SP, Space Optical Network Technology, efforts were transferred from PE 0602500F, Multidisciplinary Space Technology, Project 5082, Optical Networking Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops the technology base for the next generation of ultra-wide- bandwidth, multi-channeled, air and space-based communications networks on and between platforms. As the application of laser-based, point-to-point communications between satellites emerges, air and space-based optical networks, whose communications capacities are thousands of times greater than current communications satellites, become a realistic possibility. This project will assess and adapt the emerging communication and information technologies, for applications in air and space. This project will explore technologies for implementing photonic chip scale optical Code Division Multiple Access (CDMA) and Wavelength Division Multiplexed (WMD) transceivers and prototype networks, built to demonstrate the benefits associated with the advanced fiber optic, wireless, platform, and satellite networks that can be built from them. This project will develop and demonstrate technology to integrate current Radio Frequency (RF) with high data rate Optical Laser communications, along with network management techniques, tools and software to support them. These technologies have potential applications in specific military systems including reliable, high bandwidth, jam-resistant communications at the theater level, and multiplexing of multiple DoD users onto a common networking infrastructure for reduced manning and logistics.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and assess optical network technologies for application in the space environment.	0.000	0.000	1.549
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Complete demonstration of highly integrated multi-gigabit optical network with 4 x 4 optical data router and optical backbone interface chips. Initiate demonstration of highly integrated multi-gigabit optical network with 16 x 16 optical data router and optical backbone interface chips.			
(U) MAJOR THURST: Develop and assess existing and emerging Optical CDMA and WDM modulation schemes and protocols for use in space-based optical networks.	0.000	0.000	3.100
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Continue design and development of optical burst switching and optical label switching protocols for applicability to air and space-based optical networks. Continue flight demonstration of industry standard single mode optical communications bus interface chip for airborne platforms.			
(U) MAJOR THURST: Develop and demonstrate heterogeneous, seamless, secure, self-configuring high capacity air/space/surface wireless networks that integrate current RF with high data rate Optical Laser communications.	0.000	0.000	6.642

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 66SP Space Optical Network Tech

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	Note: In FY 2005, greater emphasis was placed on laser communication technologies.			
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Continue design and development of waveform, coding, management, and atmospheric mitigation technologies for a combined RF/laser communications terminal. Demonstrate development of industry standard single mode optical communications bus for airborne platforms and air-to-air or air-to-ground RF and laser networked communication.			
(U)	Total Cost	0.000	0.000	11.291

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0603789F, C3I Advanced Development.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

PE NUMBER: 0602805F
PE TITLE: Dual Use Science & Technology

Exhibit R-2, RDT&E Budget Item Justification	DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602805F Dual Use Science & Technology

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	3.955	0.986	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
4770	Dual Use Science and Technology (S&T)	3.955	0.986	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2006, this PE will be cancelled as a result of higher Air Force priorities.

(U) A. Mission Description and Budget Item Justification

This program seeks to leverage industry investments with interests in advanced technologies of mutual advantage to the Air Force and the commercial sector. A key objective of this program is for the Air Force to stimulate the development of dual use technologies so as to provide greater access to commercially developed technologies and to promote more affordable defense systems that maintain battlespace superiority. A critical component of this program is the cost-sharing requirement from industry and specific Air Force programs. The cooperative funding assures joint commitment to the transition and dual use development efforts of successfully demonstrated technologies. Specific projects are determined through annual competitive solicitations. Technology areas considered may include advanced materials and manufacturing; sensors; advanced propulsion, power, and fuel efficiency; information and communications technologies; and weapon systems sustainment. Note: In FY 2006, Congress added $1.0 million for Project HMA. This program is Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	5.105	0.000	0.000
(U)	Current PBR/President's Budget	3.955	0.986	0.000
(U)	Total Adjustments	-1.150	0.986	
(U)	Congressional Program Reductions	0.000		
	Congressional Rescissions	-0.004	-0.014	
	Congressional Increases	0.000	1.000	
	Reprogrammings	-1.013		
	SBIR/STTR Transfer	-0.133		

(U) Significant Program Changes:

In FY 2006, this PE will be cancelled as a result of higher Air Force priorities.

C. Performance Metrics

(U) Under Development

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602805F Dual Use Science & Technology	PROJECT NUMBER AND TITLE: 4770 Dual Use Science and Technology (S&T)	

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4770	Dual Use Science and Technology (S&T)	3.955	0.986	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, this PE will be cancelled as a result of higher Air Force priorities.

(U) A. Mission Description and Budget Item Justification

This program seeks to leverage industry investments with interests in advanced technologies of mutual advantage to the Air Force and the commercial sector. A key objective of this program is for the Air Force to stimulate the development of dual use technologies so as to provide greater access to commercially developed technologies and to promote more affordable defense systems that maintain battlespace superiority. A critical component of this program is the cost-sharing requirement from industry and specific Air Force programs. The cooperative funding assures joint commitment to the transition and dual use development efforts of successfully demonstrated technologies. Specific projects are determined through annual competitive solicitations. Technology areas considered may include advanced materials and manufacturing; sensors; advanced propulsion, power, and fuel efficiency; information and communications technologies; and weapon systems sustainment. Note: In FY 2006, Congress added $1.0 million for Project HMA. This program is Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Advance materials and manufacturing technologies. Technology areas of interest include smart and adaptive skins, corrosion resistant and genetically designed coatings, evaluation techniques, nano-scale electronics, specialized materials for space launch, and agile materials for use in force protection.	0.950	0.000	0.000
(U) In FY 2005: Enhanced the capability, performance, durability, and affordability of Air Force and commercial air and space systems.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Design and develop advanced sensors and associated technologies. Technology areas of interest include real-time, high-resolution, precision imaging; sensitive ambient electromagnetic (e.g., infrared) detection; and high-speed, precision temporal, spatial, and attitude sensors and controllers.	0.755	0.000	0.000
(U) In FY 2005: Expanded the design, efficiency, and affordability of advanced sensors and associated technologies for military and commercial air and space platforms.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602805F Dual Use Science & Technology	PROJECT NUMBER AND TITLE 4770 Dual Use Science and Technology (S&T)

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST: Develop propulsion, power, energy, and fuel efficiencies and affordability. Technology areas of interest include engine and motor performance and emissions; turbine and hypersonic engine combustion and dynamics; power processing, storage, and conversion; and smart engine health monitoring techniques.	0.950	0.000	0.000
(U)	In FY 2005: Enhanced the operational capability, expand the life, and reduce the cost of military and commercial air and space operations.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Advance information and communication technologies. Technology areas of interest include collecting, synthesizing, and encoding pertinent information; securing high-speed and reliable fusion, accuracy, security, and transmission of information; and presenting relevant information in an efficient, timely, consistent, and easily understood manner.	0.650	0.000	0.000
(U)	In FY 2005: Promoted new technologies to collect, collate, process, distribute, recall, and secure high-accuracy data on and across military and commercial platforms.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Enhance weapon systems sustainment to prolong system life and reduce life cycle costs. Technology areas of interest include avionics; materials fatigue and fracture; corrosion; cost-effective techniques for non-invasive, real-time monitoring of system health/performance; and associated environmental impacts.	0.650	0.000	0.000
(U)	In FY 2005: Enhanced sustainability, reliability, maintainability, operability, efficiency, and affordability of military and commercial air and space propulsion.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Project HMA	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Project HMA.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	3.955	0.986	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602805F Dual Use Science & Technology	PROJECT NUMBER AND TITLE 4770 Dual Use Science and Technology (S&T)

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0601102F, Defense Research Sciences.									
(U) PE 0602102F, Materials.									
(U) PE 0602201F, Aerospace Flight Dynamics.									
(U) PE 0602202F, Human Effectiveness.									
(U) PE 0602203F, Aerospace Propulsion.									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0602601F, Space Technology.									
(U) PE 0602602F, Conventional Munitions.									
(U) PE 0602605F, Directed Energy Technology.									
(U) PE 0602702F, Command Control and Communications.									
(U) PE 0603112F, Advanced Materials for Weapon Systems.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603211F, Aerospace Structures.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602805F Dual Use Science & Technology**	PROJECT NUMBER AND TITLE **4770 Dual Use Science and Technology (S&T)**

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

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

(U) PE 0603231F, Crew Systems and Personnel Protection Technology.

(U) PE 0603270F, Electronic Combat Technology.

(U) PE 0603401F, Advanced Spacecraft Technology.

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.

(U) PE 0603601F, Conventional Weapons Technology.

(U) PE 0603605F, Advanced Weapons Technology.

(U) PE 0603789F, C3I Advanced Development.

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

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0602890F
PE TITLE: High Energy Laser Research

Exhibit R-2, RDT&E Budget Item Justification	DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602890F High Energy Laser Research

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	48.867	46.669	50.166	50.737	55.026	56.288	57.256	Continuing	TBD
5096 High Energy Laser Research	48.867	46.669	50.166	50.737	55.026	56.288	57.256	Continuing	TBD

(U) A. Mission Description and Budget Item Justification

This program funds Department of Defense (DoD) high energy laser (HEL) applied research through the HEL Joint Technology Office. HEL weapon systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and the ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall DoD HEL Science and Technology program. In general, efforts funded under this program are chosen for their potential to have major impact on multiple HEL systems and on multiple Service missions while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics, propagation, and free electron lasers. Note: In FY 2006, Congress added $1.2 million for the High Power Fiber Laser Program, and $0.5 million for Oxygen Laser Optical Source. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	50.229	45.678	49.598
(U)	Current PBR/President's Budget	48.867	46.669	50.166
(U)	Total Adjustments	-1.362	0.991	
(U)	Congressional Program Reductions		-0.034	
	Congressional Rescissions	-0.050	-0.675	
	Congressional Increases		1.700	
	Reprogrammings			
	SBIR/STTR Transfer	-1.312		
(U)	Significant Program Changes:			

Not Applicable.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602890F High Energy Laser Research	PROJECT NUMBER AND TITLE: 5096 High Energy Laser Research

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5096	High Energy Laser Research	48.867	46.669	50.166	50.737	55.026	56.288	57.256	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This program funds Department of Defense (DoD) high energy laser (HEL) applied research through the HEL Joint Technology Office. HEL weapon systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and the ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall DoD HEL Science and Technology program. In general, efforts funded under this program are chosen for their potential to have major impact on multiple HEL systems and on multiple Service missions while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics, propagation, and free electron lasers. Note: In FY 2006, Congress added $1.2 million for the High Power Fiber Laser Program, and $0.5 million for Oxygen Laser Optical Source. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST/CONGRESSIONAL ADD: Explore solid state lasers that have potential for the quickest impact in future HEL weapons because of their inherent small size and the fact that they require only electrical energy in order to run, thereby greatly simplifying systems engineering and supportability. Note: This effort includes Congressional Adds of $3.0 million in FY 2005.	11.679	6.238	7.367

(U) In FY 2005: Developed component technologies such as laser gain media with improved opto-thermal-mechanical properties. Developed thermal management techniques leading to reduced optical distortion, modular and scalable architectures for power scaling including beam combining, and optical ceramic materials. For ceramics, enhanced manufacturing processes for laser applications, fully characterized materials, and set stage for performance comparison to single crystal material. Developed and demonstrated more efficient and higher brightness diode arrays that can pump fiber lasers. Developed and demonstrated fiber laser beam combining through spectral and tiled aperture approaches. Developed and demonstrated a heat exchanger building block for phase change thermal management/storage systems. Conducted Service and Agency proposal call for FY 2005 and funded first year of selected efforts. Funded second year of FY 2004 industry proposal call efforts.

(U) In FY 2006: Conduct research to enable power scaling with reduced optical distortion, improved efficiency, and improved size and weight characteristics. Develop technology that will lead to improved fieldability, serviceability, and ruggedness. Develop scalable architectures for laser power scaling including technologies for beam combining. Examine architecture improvements, such as elimination of free-space optics in fiber systems. Conduct an industry

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602890F High Energy Laser Research	PROJECT NUMBER AND TITLE 5096 High Energy Laser Research

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	proposal call for FY 2006, fund first year of selected efforts, and fund second year of FY 2005 Service and Agency efforts.			
(U)	In FY 2007: Continue maturing technologies that will provide system level performance commensurate with fieldable devices. Provide power scaling with good beam quality and suitable size and weight. Develop technology that will lead to improved fieldability, serviceability, and ruggedness. Explore power scaling technology that will lead to a broader application space. Develop new power-scalable architectures including technologies for beam combining. Continue to fund the industry proposal call efforts started in FY 2006, conduct Service and Agency proposal call for FY 2007, and fund first year of selected efforts.			
(U)				
(U)	MAJOR THRUST: Explore free electron lasers (FEL) that have potential in future HEL weapons because they require only electrical energy in order to run and can be designed to operate at the best wavelength for a specific application within a large range of wavelengths.	8.727	8.513	9.425
(U)	In FY 2005: Developed FEL system components for power scaling. The 10 kilowatt laboratory demonstrator will be used as a test bed. Developed a separate photocathode test bed and refine photocathode models as a tool to design advanced robust, long-life photocathodes. Fabricated a high average current radio frequency cavity and study beam breakup mitigation technology. Performed laboratory tests to determine the suitability of high power optical components. Determined if currently planned technology for power scaling of the optical cavity will be satisfactory; explored alternatives as necessary. Conducted Service and Agency proposal call for FY 2005 and funded first year of selected efforts. Funded second year efforts on FY 2004 industry proposal call.			
(U)	In FY 2006: Conduct research in power scaling for powers in the 100 kilowatt class. Design high-average-current photocathode and injector capability, suitable beam-breakup thresholds, and power scaling capability of the optical resonator. Continue component testing with the 10 kilowatt laboratory demonstrator to define a development path for scaling to a 100 kilowatt class field test demonstrator and eventual megawatt class FEL. Conduct an industry proposal call for FY 2006, fund first year of selected efforts, and fund second year of FY 2005 Service and Agency efforts.			
(U)	In FY 2007: Conduct system-level technology development and trade studies to facilitate scaling of FELs to weapon class power levels and shipboard integration. As appropriate, augment the existing 10 kilowatt laboratory testbed or build new testbeds with components showing traceability to larger systems, including radio frequency power systems, and optical and electron beam lines. Continue to investigate the development path for scaling toward 100 kilowatt field test demonstrator and eventual megawatt class FEL. Continue to fund the industry proposal call efforts started in FY 2006, conduct Service and Agency proposal call for FY 2007, and fund first year of selected efforts.			
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602890F High Energy Laser Research	PROJECT NUMBER AND TITLE 5096 High Energy Laser Research

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop advanced solid state laser technologies that are applicable to future HEL weapon laser devices. Note: This effort included Congressional Adds of $2.4 million in FY 2005.	12.551	13.805	15.092
(U)	In FY 2005: Demonstrated components for power scaling technology in concert with the 25 kilowatt Joint High Power Solid State Laser (JHPSSL). Developed hardware that can be used for quantitative characterization of the 25 kilowatt JHPSSL lasers. Developed enabling technologies that will support improved performance at 25 kilowatt and are traceable to 100 kilowatt.			
(U)	In FY 2006: Mature enabling technologies through applied research necessary for the demonstration of solid state lasers at initial weapon-grade power levels. Support technology development for the JHPSSL system in the 100 kilowatt program phase.			
(U)	In FY 2007: Continue to support the JHPSSL program design and demonstration of 100 kilowatts devices. Examine the potential for new technologies, such as dopant-tailored ceramics to impact this program.			
(U)				
(U)	MAJOR THRUST: Develop beam-control technologies that are directly applicable to surface, air, and space mission areas. Results of these activities will be transitioned to near-term HEL systems and will also serve to enhance the HEL related technology base and industrial capability. Develop atmospheric characterization technologies and techniques aimed at making precise absorption measurements in interesting atmospheric windows, measuring and assimilating information on turbulence at locations relevant to tactical HEL systems, and developing and testing real-time characterization tools to assist the HEL operator.	10.147	8.434	9.329
(U)	In FY 2005: Developed architecture and component technology that can be used to support integrated beam-control technology demonstrations. Addressed multiple architecture approaches, such as passive and active wavefront control, and target-in-the loop as well as wavefront-reconstruction based techniques. Explored next-generation component technology for phase control such as micro-electrical-mechanical and high power, high speed spatial light modulators. Explored improvement of optical coatings technology. Developed technology for conformal windows and improved wavefront sensors for high scintillation environments. Conducted atmospheric characterization and propagation studies for low-altitude tactical scenarios in order to increase the lethal range. Conducted Service and Agency proposal call for FY 2005 and funded first year of selected efforts. Funded second year efforts on FY 2004 industry proposal call.			
(U)	In FY 2006: Develop technology to support high performance beam control systems and integrated demonstrations. Explore advanced components and control techniques for difficult environments such as those found in high speed flight, high turbulence, and extended range. Advanced techniques include conformal and tiled apertures, and fiber-based technologies with improved isolation from platform disturbance. Develop component technology including durable optical coatings. Provide critical technology options for use in tactical scenarios on platforms such			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602890F High Energy Laser Research	PROJECT NUMBER AND TITLE 5096 High Energy Laser Research

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	as aircraft, ground vehicles, and ships. Continue the study of atmospheric limitations in low-altitude tactical scenarios such as turbulence, thermal blooming, and with platform disturbances. Begin to plan an outdoor thermal blooming experiment. Conduct an industry proposal call for FY 2006, fund first year of selected efforts, and fund second year of FY 2005 Service and Agency efforts.			
(U)	In FY 2007: Mature existing and develop new technologies that support integrated beam control demonstrations. Continue technology development to support next-generation control technologies, such as all-solid fiber laser systems with conformal apertures and active control for boundary-layer mitigation. Provide technology options for laser use on multiple platforms (aircraft, ground vehicles, and ships). Continue study of atmospheric compensation technology. Continue to fund the industry proposal call efforts started in FY 2006, conduct Service and Agency proposal call for FY 2007, and fund first year of selected efforts.			
(U)				
(U)	MAJOR THRUST: Develop chemical laser technologies that provide higher performance and better supportability. Results of these activities will result in chemical lasers that are lighter and more affordable. Emphasis in this area is being reduced based on the relative maturity of chemical lasers.	2.511	4.392	4.859
(U)	In FY 2005: Developed and demonstrated closed-cycle chemical lasers, especially chemical oxygen iodine lasers. Developed chemical laser generators that are capable of operating in a gravity free environment and conducted proof-of-concept testing of these devices. Evaluated advanced chemical or electrochemical cycles that promote improved recycling and use less hazardous materials. Conducted Service and Agency proposal call for FY 2005 and funded first year of selected efforts. Funded second year efforts on FY 2004 industry proposal call.			
(U)	In FY 2006: Continue to develop and demonstrate closed-cycle chemical lasers, especially chemical oxygen iodine laser-derived devices. Conduct technology development/experiments to allow selection of the most promising chemical generators and chemical regeneration techniques that can be scaled for tactical weapon applications. Conduct an industry proposal call for FY 2006, fund first year of selected efforts, and fund second year of FY 2005 Service and Agency efforts.			
(U)	In FY 2007: Continue to develop and demonstrate closed-cycle chemical lasers, especially chemical oxygen iodine laser-derived devices. Conduct technology development/experiments to allow selection of the most promising chemical laser generators and chemical regeneration techniques that can be scaled for tactical weapon system applications. Continue to fund the industry proposal call efforts started in FY 2006, conduct Service and Agency proposal call for FY 2007, and fund first year of selected efforts.			
(U)				
(U)	MAJOR THRUST: Develop lethality technologies that concentrate on providing a strong scientifically-based understanding of laser kill mechanisms to allow the design of future HEL systems with the maximum kill probability	3.252	3.611	4.094

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602890F High Energy Laser Research	PROJECT NUMBER AND TITLE 5096 High Energy Laser Research

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	for the minimum system size and cost.			
(U)	In FY 2005: Explored feasibility of developing a predictive, physics-based model for target lethality that would reduce the need for detailed lethality testing with the large number of known targets. Developed databases that will be accepted by the HEL community and validated models that will be available to systems designers. Developed a subset of target folders for future tactical laser weapons. Conducted Service and Agency proposal call for FY 2005 and funded first year of selected efforts.			
(U)	In FY 2006: Continue work to establish a predictive, physics-based methodology for prediction of target lethality based on previously gained understanding of the mechanisms of interaction between laser beams and targets. Continue to develop databases that will be accepted by the high energy laser (HEL) community and validated models that will be available to systems designers. Conduct an industry proposal call for FY 2006, fund first year of selected efforts, and fund second year of FY 2005 Service and Agency efforts.			
(U)	In FY 2007: Continue to develop lethality information that will be accepted by the HEL community and validated models that will be available to systems designers. Continue to fund the contract efforts started in FY 2006, conduct Service and Agency proposal call for FY 2007, and fund first year of selected efforts.			
(U)				
(U)	CONGRESSIONAL ADD: High Power Fiber Laser Program.	0.000	1.183	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for the High Power Fiber Laser Program.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Oxygen Laser Optical Source.	0.000	0.493	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for the Oxygen Laser Optical Source.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	48.867	46.669	50.166

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602500F, Multi-Disciplinary Space Technology.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602890F High Energy Laser Research**	PROJECT NUMBER AND TITLE **5096 High Energy Laser Research**

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

(U) PE 0601108F, High Energy Laser Research Initiatives.

(U) PE 0603444F, Maui Space Surveillance System.

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.

(U) PE 0603605F, Advanced Weapons Technology.

(U) PE 0603924F, High Energy Laser Advanced Technology Program.

(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.

(U) PE 0602605F, Directed Energy Technology.

(U) PE 0602307A, Advanced Weapons Technology.

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

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

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0603112F
PE TITLE: Advanced Materials for Weapon Systems

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	61.305	70.100	48.901	43.519	45.465	46.366	47.138	Continuing	TBD
2100	Laser Hardened Materials	22.836	28.040	33.624	28.583	31.023	31.667	32.262	Continuing	TBD
3153	Non-Destructive Inspection Development	6.262	12.516	3.945	3.990	4.332	4.414	4.483	Continuing	TBD
3946	Materials Transition	25.694	23.128	3.911	3.958	4.241	4.300	4.300	Continuing	TBD
4918	Deployed Air Base Demonstrations	6.513	6.416	2.305	2.344	2.544	2.596	2.645	Continuing	TBD
77SP	Advanced Space Materials	0.000	0.000	5.116	4.644	3.325	3.389	3.448	Continuing	TBD

Note: In FY 2007, Project 77SP, Advanced Space Materials, efforts will be transferred from PE 0603500F, Multidisciplinary Space Technology, Project 5032, Advanced Space Materials, in order to more effectively manage and provide oversight of the efforts. Funds for the FY 2006 Congressionally-directed Hybrid Bearing in the amount of $2.1 million and Design Manual for Titanium Honeycomb Sandwich Composite in the amount of $3.3 million are in the process of being moved to PE 0602203F, Aerospace Propulsion, and to PE 0603211F, Aerospace Technology Dev/Demo, respectively, from PE 0603112F, Advanced Materials for Weapon Systems, for execution. Funds for the FY 2006 Congressionally-directed Room Temperature Nanocrystalline Diamond Coating for De-Icing in the amount of $1.0 million and Non-Destructive Testing (NDI) Corrosion Detection in the amount of $1.0 million are in the process of being moved to PE 0603112F, Advanced Materials for Weapon Systems, from PE 0401318F, CV-22, and from PE 0605011F, RDT&E for Aging Aircraft, respectively, for execution.

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates materials technology for transition into Air Force systems. The program has four projects which develop: (1) hardened materials technologies for the protection of aircrews and sensors; (2) non-destructive inspection and evaluation technologies; (3) transition data on structural and non-structural materials for aerospace applications; and (4) airbase operations technologies including deployable base infrastructure, force protection, and fire fighting capabilities. Note: In FY 2006, Congress added $1.2 million for Reduced Composite Manufacturing Costs Through the Application of Advanced Textile Technology, $2.6 million for XD-2 Explosives Detection System, $5.0 million for the Metals Affordability Initiative, $1.0 million for Coated Field Repair, $1.5 million for Transparent Conductive Polymer Technology Development, $1.0 million for Materials Integrity Management Research for AF, $3.3 million for Design Manual for Titanium Honeycomb Sandwich Composite, $1.0 million for Advanced Composite Processes for Unmanned Aerial Vehicles (UAVs), $1.0 million for Continuous Integrated Vehicle Monitoring System, $1.0 million for Ultra-Lightweight Composites, $2.1 million for Hybrid Bearing, $2.6 million for Large Panel Sapphire Producability, $1.7 million for Hydrothermal Oxidation, $2.1 million for Assessing Aging Military Aircraft, $2.5 million for Stealth Radar Absorbing Material (RAM) Coatings, and $4.8 million for Aging Military Aircraft (A/C) Fleet Support at National Institute for Aviation Research. 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.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	64.905	36.714	43.162
(U)	Current PBR/President's Budget	61.305	70.100	48.901
(U)	Total Adjustments	-3.600	33.386	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.050	-1.014	
	Congressional Increases		34.400	
	Reprogrammings	-2.055		
	SBIR/STTR Transfer	-1.495		

(U) Significant Program Changes:

In FY 2007, Project 77SP, Advanced Space Materials, efforts will be transferred from PE 0603500F, Multidisciplinary Space Technology, Project 5032, Advanced Space Materials, in order to more effectively manage and provide oversight of the efforts.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **03 Advanced Technology Development (ATD)**

PE NUMBER AND TITLE: **0603112F Advanced Materials for Weapon Systems**

PROJECT NUMBER AND TITLE: **2100 Laser Hardened Materials**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2100 Laser Hardened Materials	22.836	28.040	33.624	28.583	31.023	31.667	32.262	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced materials technologies that enhance protection for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in threat environments. Advanced materials technologies are also developed and demonstrated to enhance protection for Air Force sensor systems to ensure safety, survivability, and operability in threat environments.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced materials technologies that enhance hardening for sensors, avionics, and components to increase survivability and mission effectiveness of aerospace systems. Note: Increase in FY 2006 and out is due to an increased emphasis on sensor protection. This effort includes Congressional Add funding of $1.5 million in FY 2005 and $2.6 million in FY 2006 for Large Panel Sapphire Producability.	12.438	21.104	26.487
(U) In FY 2005: Demonstrated hardening options that can be incorporated into selected electro-optical sensor systems. Initiated hardening development for multispectral and hyperspectral sensor systems.			
(U) In FY 2006: Develop a mid-wavelength infrared testbed based on a candidate optical system. Evaluate solid state limiter materials having potential for dual band operation. Evaluate jamming and damage phenomenologies for large format charge coupled devices (CCD).			
(U) In FY 2007: Mature hardening technology and develop a hardened candidate system. Develop candidate dual band limiter materials. Develop protection strategies for large format CCDs.			
(U)			
(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced materials technologies that enhance protection for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in a threat environment. Note: This effort includes Congressional Add funding of $1.7 million in FY 2005 for Plasma Enhanced Chemical Vapor Deposition for Advanced Laser Program.	10.398	6.936	7.137
(U) In FY 2005: Transitioned candidate materials technology advancements to improve performance of daytime statistical filter technology. Demonstrated night vision goggle (NVG) compatible peripheral protection eyewear. Characterized the performance of breadboard panoramic NVG (PNVG)/NVG systems incorporating agile filter technology. Developed agile filter and optical limiter technologies.			
(U) In FY 2006: Develop and characterize an NVG brassboard system using state-of-the-art agile filters and optical power limiters. Continue to develop agile filter and optical limiter technologies.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER AND TITLE 2100 Laser Hardened Materials

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
(U) In FY 2007: Demonstrate brassboard performance using state-of-the-art agile filters and optical power limiters. Characterize and incorporate agile filter and optical limiter technologies into devices for Air Force applications.			
(U) Total Cost	22.836	28.040	33.624

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602102F, Materials.									
(U) PE 0602202F, Human Effectiveness Applied Research.									
(U) PE 0603231F, Crew Systems and Personnel Protection Technology.									
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.									
(U) PE 0604706F, Life Support Systems.									
(U) This project has been coordinated through the Tri-Service Laser Hardened Materials and Structures Group and the Joint Service Agile Laser Eye Protection Program.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER AND TITLE: 3153 Non-Destructive Inspection Development

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3153	Non-Destructive Inspection Development	6.262	12.516	3.945	3.990	4.332	4.414	4.483	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the FY 2006 Congressionally-directed Non-Destructive Testing (NDI) Corrosion Detection in the amount of $1.0 million are in the process of being moved to PE 0603112F, Advanced Materials for Weapon Systems, from PE 0605011F, RDT&E for Aging Aircraft, respectively, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced nondestructive inspection/evaluation (NDI/E) technologies to monitor performance integrity and to detect failure causing conditions in weapon systems components and materials. NDI/E capabilities greatly influence and/or limit many design, manufacturing, and maintenance practices. This project provides technology to satisfy Air Force requirements to extend the lifetime of current systems through increased reliability and cost-effectiveness at field and depot maintenance levels. Equally important is assuring manufacturing quality, integrity, and safety requirements.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate advanced technologies to improve capabilities to inspect for cracks and other damage to extend the total safe life of turbine engines.	1.292	1.042	0.891
(U) In FY 2005: Developed methods to detect and characterize damage in repaired (linear friction welded) turbine engine components. Demonstrated enhanced NDI/E approaches to extend the life of fracture-critical gas turbine engine components.			
(U) In FY 2006: Demonstrate methods to detect and characterize damage in repaired (linear friction welded) turbine engine components. Validate enhanced NDI/E approaches to extend the life of fracture-critical gas turbine engine components.			
(U) In FY 2007: Transition methods to detect and characterize damage in repaired (linear friction welded) turbine engine components. Transition enhanced NDI/E approaches to extend the life of fracture-critical gas turbine engine components.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate advanced inspection technologies supporting low-observable (LO) systems to enhance affordability and ensure full performance and survivability.	0.898	0.624	0.315
(U) In FY 2005: Developed a portable diagnostic probe that is broadband and will provide complex electromagnetic material properties. Developed a portable, multifunctional, multi-platform diagnostics tool for use in battle damage repair of LO materials and structures.			
(U) In FY 2006: Develop and demonstrate a portable, multifunctional, multi-platform diagnostics tool for use in battle damage assessment and repair of LO materials and structures.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603112F Advanced Materials for Weapon Systems**	PROJECT NUMBER AND TITLE **3153 Non-Destructive Inspection Development**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Transition a portable, multifunctional, multi-platform diagnostics tool for use in battle damage assessment and repair of LO materials and structures.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced technologies for improved capabilities in materials corrosion, fatigue monitoring, and testing of aging aircraft to reduce operations and maintenance costs. These technologies will contribute to full operability and safety of the aircraft fleet. Note: This effort includes Congressional Add funding of $1.2 million in FY 2005 for Quantitative Inspection Techniques for Assessing Aging of Military Aircraft and $6.9 million in FY 2006 ($2.1 million for Assessing Aging Military Aircraft and $4.8 million for Aging Military A/C Fleet Support at National Institute for Aviation Research).	2.322	8.022	1.343
(U)	In FY 2005: Transitioned advanced technologies for improved capabilities in detection and characterization of corrosion of joints in aging aircraft. Demonstrated advanced methods such as magneto-resistive arrays to detect cracks in multiple layers to meet aging aircraft life extension requirements.			
(U)	In FY 2006: Transition advanced electromagnetic techniques to detect cracks in multiple layers to meet aging aircraft life extension requirements. Identify and develop application-focused NDI/E technologies to meet emerging inspection requirements for aging aircraft.			
(U)	In FY 2007: Demonstrate application-focused NDI/E technologies to meet emerging inspection requirements for aging aircraft.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced systems status monitoring technologies to provide on-board and embedded sensing to gain continuous awareness of the state of key subsystems. Note: This effort includes Congressional Add funding of $1.6 million in FY 2005 ($1.1 million for Materials Integrity Management Research and $0.5 million for Continuous Integrated Vehicle Health Monitoring System) and $2.0 million in FY 2006 ($1.0 million for Materials Integrity Management Research for AF and $1.0 million for Continuous Integrated Vehicle Monitoring System).	1.750	2.828	1.396
(U)	In FY 2005: Developed sensors to monitor real-time health of high-temperature protection systems. Developed smart sensor technologies for wiring health analysis. Developed novel field-level inspection tools for assessing the structural health of airframes.			
(U)	In FY 2006: Continue development of sensors to monitor real-time health of high-temperature protection systems. Continue development of smart sensor technologies for wiring health analysis. Continue development of field-level inspection tools for assessing the structural health of airframes.			
(U)	In FY 2007: Validate optimal sensing approaches for real-time health monitoring of high-temperature protection systems and characterize power scavenging and signal transmission issues. Validate smart sensor technologies for			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER AND TITLE 3153 Non-Destructive Inspection Development

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
wiring health analysis. Validate field-level inspection tools for assessing the structural health of airframes.			
(U) Total Cost	6.262	12.516	3.945

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602102F, Materials.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER AND TITLE: 3946 Materials Transition	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3946 Materials Transition	25.694	23.128	3.911	3.958	4.241	4.300	4.300	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the FY 2006 Congressionally-directed Hybrid Bearing in the amount of $2.1 million and Design Manual for Titanium Honeycomb Sandwich Composite in the amount of $3.3 million are in the process of being moved to PE 0602203F, Aerospace Propulsion, and to PE 0603211F, Aerospace Technology Dev/Demo, respectively, from PE 0603112F, Advanced Materials for Weapon Systems, for execution. Funds for the FY 2006 Congressionally-directed Room Temperature Nanocrystalline Diamond Coating for De-Icing in the amount of $1.0 million are in the process of being moved to PE 0603112F, Advanced Materials for Weapon Systems, from PE 0401318F, CV-22, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced materials and processing technologies for fielded and planned Air Force weapon, airframe, and propulsion applications. Advanced materials and processes that have matured beyond applied research are characterized, critical data are collected, and critical evaluations in the proposed operating environment are performed. These design and scale-up data improve the overall affordability of promising materials and processing technologies, providing needed initial incentives for their industrial development.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced materials and processing technologies for air vehicles and subsystems to enhance the lift, propulsion, low-observable performance, and overall affordability of air vehicles. Note: This effort includes Congressional Add funding of $17.9 million in FY 2005 ($7.5 million for the Metals Affordability Initiative, $1.4 million for Advanced Composite Processes, $1.5 million for Transparent Conductive Polymer Technology Development, $3.0 million for Titanium Matrix Composites, $3.5 million for Stealth RAM Coatings, and $1.0 million for Ultra-Lightweight Composites for Ballistic and Bomb Protection) and $12.2 million in FY 2006 ($1.2 million for Reduced Composite Manufacturing Costs Through the Application of Advanced Textile Technology, $5.0 million for Metals Affordability Initiative, $1.5 million for Transparent Conductive Polymer Technology Development, $1.0 million for Advanced Composite Processes for Unmanned Aerial Vehicles (UAVs), $1.0 million for Ultra-Lightweight Composites, and $2.5 million for Stealth RAM Coatings).	22.207	16.555	3.389

(U) In FY 2005: Developed and demonstrated reliable life extension capabilities for turbine engine rotors. Demonstrated a high temperature composite for turbine engine components. Validated performance of ceramic composite materials for exhaust components in a turbine engine environment. Developed and characterized advanced materials and materials process capabilities for ultra-lightweight, ultra-high power generation for airborne directed energy weapons. Developed materials and their suitability for a mid-infrared laser source enabling aircraft infrared countermeasures. Validated and transitioned improved materials and inspection tools/processes for LO systems to enable higher mission capable rates.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603112F Advanced Materials for Weapon Systems**	PROJECT NUMBER AND TITLE **3946 Materials Transition**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Develop materials-damage predictive approaches for engine health determination and life extension capability. Transition reliable life extension capability for turbine engine rotors. Continue development and demonstration of high temperature composites for turbine engine applications and initiate transition of these materials to relevant platforms. Scale-up advanced materials and initiate scale-up of fabrication processes to increase the capabilities of coated conductors for ultra-lightweight, ultra-high power generation for airborne directed energy weapons. Evaluate materials properties for a mid-infrared laser source enabling aircraft countermeasures and integrate best material improvement methods. Investigate primer/sealer material for improved durability of LO materials in fluid contaminated areas on emerging fighter aircraft. Develop flexible/lightweight conductive gap filler for LO aircraft. Develop processes for removal of radar absorbing material on large aircraft areas. Develop hot-melt conductive fastener fill. Improve processing of room-temperature-storable radar absorbing structure repair materials. Develop nondestructive evaluation tool for limited access areas on aircraft.			
(U)	In FY 2007: Develop materials-damage predictive approaches for engine health determination and life extension capability. Complete transition of high-temperature organic matrix composites for turbine engine components. Characterize advanced materials and materials process capabilities for scaled-up processing techniques and assess process repeatability for power generation materials for airborne directed energy weapons. Demonstrate functionality of integrated methods for a mid-infrared laser source enabling aircraft countermeasures. Demonstrate flexible/lightweight conductive gap filler. Evaluate processes for removal of radar absorbing material on large aircraft areas. Demonstrate primer/sealer material for improved durability of LO materials in fluid contaminated areas on emerging fighter aircraft. Evaluate improved processing of room-temperature-storable radar absorbing structure repair materials. Demonstrate nondestructive evaluation tool for limited access areas on aircraft.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced materials and processing technologies to enhance the sustainability of Air Force aerospace systems by lowering operations and maintenance costs and ensuring the full operability and safety of systems and personnel. Note: This effort includes Congressional Add funding of $2.8 million in FY 2005 for Fast Field Repair of Coated Aircraft and Equipment and $1.0 million in FY 2006 for Coated Field Repair.	3.487	1.250	0.522
(U)	In FY 2005: Demonstrated corrosion resistant coatings and corrosion prevention compounds for aging aircraft structures applications. Developed test methodologies and evaluation techniques to determine durability and characterize failure mechanisms of hybrid structures in UAVs.			
(U)	In FY 2006: Develop test methodologies and evaluation techniques to facilitate transition of emerging materials and processes for sustainment of Air Force systems.			
(U)	In FY 2007: Continue to develop test methodologies and evaluation techniques to facilitate transition of emerging			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER AND TITLE 3946 Materials Transition

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	materials and processes for sustainment of Air Force systems.			
(U)				
(U)	CONGRESSIONAL ADD: Design Manual for Titanium Honeycomb Sandwich Composite.	0.000	3.253	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Design Manual for Titanium Honeycomb Sandwich Composite.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Hybrid Bearing.	0.000	2.070	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Hybrid Bearing.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	25.694	23.128	3.911

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602102F, Materials.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603211F, Aerospace Technology Dev/Demo.									
(U) PE 0603216F, Aerospace Propulsion and Power Technology.									
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER AND TITLE 3946 Materials Transition

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

eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER AND TITLE: 4918 Deployed Air Base Demonstrations	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4918 Deployed Air Base Demonstrations	6.513	6.416	2.305	2.344	2.544	2.596	2.645	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced, rapidly deployable airbase technologies that reduce airlift and manpower requirements, setup times, and sustainment costs, and improve protection and survivability of deployed Air Expeditionary Force (AEF) warfighters. Affordable, efficient technologies are developed and demonstrated to provide deployable infrastructure, advanced weapon system support, force protection, and fire fighting capability for deployed AEF operations.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST/CONGRESSIONAL ADD: Demonstrate and transition advanced rapidly deployable airbase infrastructure technologies that reduce airlift and manpower requirements, setup times, and sustainment costs in support of AEF operations. Note: This effort includes Congressional Add funding of $4.5 million in FY 2005 ($3.4 million for Plasma Arc/Waste to Energy Production and $1.1 million for Advanced Polymer Technology for Agile Combat Support) and $1.7 million in FY 2006 for Hydrothermal Oxidation.	5.475	2.765	1.152
(U) In FY 2005: Developed a 10 kW fuel cell power system that improves deployable power systems performance and reduces airlift requirements for support of AEF operations. Demonstrated rapid airfield assessment technologies that improve deployable systems performance and reduce airlift requirements for support of AEF operations.			
(U) In FY 2006: Demonstrate a 10 kW fuel cell power system that improves deployable power systems performance. Demonstrate packed bed fuel treatment technology to remove sulfur and integrate with both proton exchange membrane fuel cell and solid oxide fuel cell stacks. Develop advanced integrated shelter power/heating, ventilation, and air conditioning concepts that will integrate fuel cell, solar, and heat pump technologies into a highly efficient compact system that can provide total energy and air conditioning requirements for individual deployable shelters. Develop continuous load deflection technology and improved crater/spall repair materials and methodologies for improved airfield assessment and rapid repair.			
(U) In FY 2007: Demonstrate a 10 kW fuel cell power system that improves deployable power systems performance. Demonstrate packed bed fuel treatment technology. Demonstrate advanced integrated shelter power/heating, ventilation, and air conditioning concept. Continue to develop continuous load deflection technology and improved crater/spall repair materials and methodologies for improved airfield assessment and rapid repair.			
(U)			
(U) MAJOR THRUST/CONGRESSIONAL ADD: Demonstrate and transition affordable, efficient technologies to provide force protection and fire fighting capability for deployed AEF operations. Note: This effort includes Congressional Add funding of $2.6 million in FY 2006 for XD-2 Explosives Detection System.	1.038	3.651	1.153

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER AND TITLE 4918 Deployed Air Base Demonstrations

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	In FY 2005: Demonstrated deployable protective and advanced blast suppression technologies to protect deployed warfighters. Demonstrated a reduced-size full-capability fire fighting vehicle for deployed operations. Developed improved fire fighter safety technologies. Developed advanced air filtration technologies for expeditionary structures.			
(U)	In FY 2006: Demonstrate improved blast suppression technologies and fragmentation protection materials for new and existing structures. Initiate demonstration of explosive storage protective technologies. Demonstrate improved fire fighter safety technologies. Continue development of advanced air filtration technologies for expeditionary structures.			
(U)	In FY 2007: Continue demonstrating improved blast suppression technologies and fragmentation protection materials for new and existing structures and for explosive storage facilities. Complete demonstration of improved fire fighter safety technologies and transition technology to operational units. Initiate an integrated crash/rescue fire fighting demonstration. Integrate air filtration technologies into demonstration for expeditionary structures.			
(U)	Total Cost	6.513	6.416	2.305

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602102F, Materials.									
(U) PE 0603287F, Physical Security Equipment.									
(U) PE 0604617F, Agile Combat Support.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **03 Advanced Technology Development (ATD)**

PE NUMBER AND TITLE: **0603112F Advanced Materials for Weapon Systems**

PROJECT NUMBER AND TITLE: **77SP Advanced Space Materials**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
77SP Advanced Space Materials	0.000	0.000	5.116	4.644	3.325	3.389	3.448	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, Project 77SP, Advanced Space Materials, efforts will be transferred from PE 0603500F, Multidisciplinary Space Technology, Project 5032, Advanced Space Materials, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

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. Sub-scale 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 of laser threats. Reducing risk in materials technology improves the affordability, reliability, survivability, and operational performance of current and future space systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate advanced materials and processing technologies to enable revolutionary improvements in the performance of air-breathing and rocket-based aerospace vehicles and weapons.	0.000	0.000	5.116
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Develop advanced materials approaches to provide durable, maintainable high-temperature protection systems for leading edge applications on high-speed, reusable launch, and future reentry vehicle concepts. For management of the thermal and structural loads, combinations of candidate materials, including organic matrix composites, ceramics, metals, carbon foams, aerogels, heat pipes, and phase change materials, will be investigated. Develop advanced ceramic materials and processing technologies for load bearing structures designed for high-temperature, multi-cycle applications in an oxidizing environment. Develop rocket propulsion materials for liquid and solid rocket engine components and validate performance in scaled component demonstrations.			
(U) Total Cost	0.000	0.000	5.116

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Not Applicable.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603112F Advanced Materials for Weapon Systems**	PROJECT NUMBER AND TITLE **77SP Advanced Space Materials**

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0603203F
PE TITLE: Advanced Aerospace Sensors

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	41.607	39.782	55.150	54.992	58.971	50.688	50.563	Continuing	TBD
5019	Advanced RF Technology for ISR Sensors	3.106	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
665A	Advanced Aerospace Sensors Technology	12.489	12.913	14.492	15.480	16.741	17.065	17.307	Continuing	TBD
69DF	Target Attack and Recognition Technology	26.012	26.869	28.471	26.553	29.186	25.587	25.073	Continuing	TBD
88SP	Advanced Space Sensors	0.000	0.000	12.187	12.959	13.044	8.036	8.183	Continuing	TBD

Note: In FY 2006, efforts in Project 5019 will transfer to Project 665A within this PE. In FY 2007, Project 88SP, Advanced Space Sensors, efforts will transfer from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5034, Advanced Space Sensors, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

Divided into four broad project areas, this program develops technologies to enable the continued superiority of sensors from aerospace platforms. The first project develops and demonstrates advanced technologies for radio frequency (RF) sensors for aerospace intelligence, surveillance, and reconnaissance (ISR) systems. The second project develops and demonstrates advanced technologies for electro-optical (EO) sensors, radar sensors and electronic counter-countermeasures (ECCM), and components and algorithms. The third project develops and demonstrates RF and EO sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets obscured by natural or man-made means. The fourth project develops and demonstrates space sensor technologies including RF sensors, ISR sensors, EO sensors, laser warning sensors, targeting and attack radar sensors, and ECCM and communications. Together, the projects in this program develop the means to find, fix, target, track, and engage air and ground targets anytime, anywhere, and in any weather. Note: In FY 2006, Congress added $5.2 million for National Operational Radar Signature Production and Research Capability. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and electronic combat system developments that have military utility and address warfighter needs.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	43.837	35.157	42.366
(U)	Current PBR/President's Budget	41.607	39.782	55.150
(U)	Total Adjustments	-2.230	4.625	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.036	-0.575	
	Congressional Increases		5.200	
	Reprogrammings	-1.357		
	SBIR/STTR Transfer	-0.837		

(U) Significant Program Changes:

In FY 2007, Project 88SP, Advanced Space Sensors, efforts will transfer from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5034, Advanced Space Sensors, in order to more effectively manage and provide oversight of the efforts..

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE: 5019 Advanced RF Technology for ISR Sensors	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5019	Advanced RF Technology for ISR Sensors	3.106	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, efforts in this project will transfer into Project 665A within this PE.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates radio frequency (RF) aerospace surveillance sensors and signal processing for intelligence, surveillance, and reconnaissance (ISR) sensors capable of operating in adverse clutter and jamming environments. This project provides the warfighter with sensors capable of detecting and tracking both airborne (conventional and low radar cross section) and ground-based, high-value, time-critical targets. Work includes developing aerospace environmentally-qualified (vibration, shock, temperature, and radiation-hardened) sensor capabilities (including integrated electro-optical mixed signal), as well as advanced component and subsystem technologies.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop techniques for advanced air moving target indication (AMTI), ground moving target indication (GMTI), and foliage penetrating ground target indication.	1.426	0.000	0.000
(U) In FY 2005: Validated data collected for AMTI, GMTI, and foliage-obscured ground target indication through computer simulation and emulation techniques for discerning ground and air targets under multi-intelligence waveform, pulse repetition frequency, and signal processing scenarios. Planned experiment to validate techniques for multi-intelligence sensing.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate advanced radar signal processing techniques to mitigate clutter and jamming interference, and improve detection and tracking of difficult targets in hostile environments.	0.961	0.000	0.000
(U) In FY 2005: Demonstrated and evaluated knowledge-aided radar signal processing techniques for improved detection and false alarm control performance in multi-intelligence sensors. Demonstrated and evaluated adaptive processing techniques for multi-mission conformal arrays and wideband and polarization adaptive processing techniques for multi-function radar on selected advanced computing architectures for multi-mission aerospace radar applications.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 5019 Advanced RF Technology for ISR Sensors

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST: Develop and demonstrate techniques to surveil venues denied to stand off ISR platforms.	0.719	0.000	0.000
(U)	In FY 2005: Developed techniques to surveil venues denied to stand off ISR platforms, concentrating on short-range, low-cost, expendable sensors that can exploit multiple RF phenomenologies.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	3.106	0.000	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603270F, Electronic Combat Technology.									
(U) PE 0603500F, Multi-Disciplinary Advanced Space Technology.									
(U) PE 0604270F, Electronic Warfare (EW) Development.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE: 665A Advanced Aerospace Sensors Technology	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
665A	Advanced Aerospace Sensors Technology	12.489	12.913	14.492	15.480	16.741	17.065	17.307	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, efforts in Project 5019 within this PE will transfer to this project.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates aerospace sensor and processing technologies for intelligence, surveillance, and reconnaissance (ISR) and target and attack radar applications in both manned and unmanned platforms, including electro-optical (EO) sensors and electronic counter-countermeasures for radars. It provides aerospace platforms with the capability to precisely detect, track, and target both airborne (conventional and low radar cross section) and ground-based, high-value, time-critical targets in adverse clutter and jamming environments. Project activities include developing multi-function radar and electronic combat technology. Desired warfighting capabilities include the ability to detect concealed targets in difficult background conditions.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop integrated EO sensor technology to search, detect, locate, and identify air and ground targets at ranges significantly longer than currently achievable, including targets that are camouflaged, low-observable, or employ other means of deception.	2.033	2.520	4.175

(U) In FY 2005: Demonstrated multi-spectral passive cueing in an airborne environment. Extended performance of ground demonstration sensor with integrated key systems for modular testing to flying test-bed configuration.

(U) In FY 2006: Complete multi-spectral passive cueing demonstration in an airborne environment. Begin development of a multi-function active/passive EO/infrared (IR) sensor demonstration system to detect, locate, and identify difficult targets in both obscured and urban environments for ISR applications. Analyze advanced passive and multi-function active sensing methods to optimize detection and identification of difficult targets. Perform preliminary design for multi-mode unmanned aerial vehicle based sensor, including platform integration plans. Design and fabricate optical components for long wave infrared spectral/polarimetric imager for high altitude sensor. Conduct in-house target/background characterization studies with modified long wave infrared imaging spectrometer.

(U) In FY 2007: Continue development of a multi-function active/passive EO/IR sensor demonstration system to detect, locate, and identify difficult targets in both obscured and urban environments for ISR applications. Finalize analysis of advanced passive and multi-function active sensing methods to optimize detection and identification of difficult targets. Complete design for multi-mode unmanned aerial vehicle based sensor, including platform integration plans. Initiate development of coarse to fine sensing methodologies which progress from wide area search to pinpoint identification and characterization. Incorporate long wave infrared spectral/polarimetric imager into high altitude

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 665A Advanced Aerospace Sensors Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	sensor. Conduct flight test to demonstrate target detection capability.			
(U)				
(U)	MAJOR THRUST: Develop EO sensor technologies to detect and locate camouflaged and concealed targets for aerospace ISR applications.	4.570	1.645	0.831
(U)	In FY 2005: Completed integration and testing of a demonstration sensor for high altitude reconnaissance aircraft. Performed flight characterization and assessed signature-based data processing performance.			
(U)	In FY 2006: Extend performance of a demonstration sensor for high altitude reconnaissance aircraft to incorporate an emissive spectral sensing capability. Fabricate, laboratory integrate, and test emissive spectrometer components.			
(U)	In FY 2007: Complete fabrication and testing of demonstration system for high altitude aircraft incorporating reflective and emissive spectral sensing capability for day and night operations. Perform flight characterization and support transition to acquisition center.			
(U)				
(U)	MAJOR THRUST: Develop technologies to maximize positional accuracy, timing accuracy, and exploitation techniques to improve offensive and defensive combat capabilities.	0.881	1.787	2.422
(U)	In FY 2005: Designed critical experiments for assured reference technologies to maximize positional accuracy, timing accuracy, and exploitation techniques for network centric engagement. Developed automatic multi-intelligence sensor data registration technology for improved geo-location performance. Expanded virtual flight test simulation technology for improved assessment of precise reference sensing networks.			
(U)	In FY 2006: Develop critical experiments using virtual flight test simulation to characterize assured reference technologies for net centric warfare. Design follow-on distributed position, navigation, and timing (PNT) advanced technology demonstration to optimize time-sensitive targeting, battlespace awareness, and persistent ISR capabilities. Improve report, track, and image georegistration technologies for multi-intelligence sensor data.			
(U)	In FY 2007: Demonstrate critical experiments using virtual flight test simulation to characterize assured reference technologies for net centric warfare. Develop follow-on distributed PNT advanced technology demonstration to optimize time-sensitive targeting, battlespace awareness, and persistent ISR capabilities. Develop sensor phenomenology-based georegistration for imagery and perform lab tests of multi-intelligence georegistration.			
(U)				
(U)	MAJOR THRUST: Develop, test, evaluate, and demonstrate lightweight, low power, compact radio frequency (RF) sensors to detect, track, and target high-value, time-critical targets that are difficult to detect through either stealth or concealment and enable persistent ISR from an unmanned aerial vehicle (UAV). Develop and validate long-range ISR sensor technologies and techniques for the detection and track of advanced air and ground targets. Advanced target characteristics include targets with low radar cross section, concealment capabilities, or electronic	2.528	6.449	5.948

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 665A Advanced Aerospace Sensors Technology

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
counter-countermeasures.			
(U) In FY 2005: Demonstrated in the laboratory evolved multi-intelligence techniques. Demonstrated "mini" UAV concept of operation and RF sensor performance improvements in the detection, tracking, and targeting of high-value, time-critical targets. Developed RF receiver technologies to detect, characterize, and encode difficult signals to assist in the detection and location of high-value, time-critical targets.			
(U) In FY 2006: Flight test a lightweight, low profile multi-function active electronically scanned array on an airborne test bed to demonstrate integrated radar technology capability. Analyze data from flight test and predict system performance on target platforms using advanced computational techniques. Demonstrate accurate, real-time detection and location with enhanced millimeter wave sensor. Begin demonstration of the RF sensors for an integrated EO/RF sensor suite for UAVs with severe size, weight, and power constraints, to enable single platform persistent ISR capability compatible with a system of systems architecture. Construct a multi-intelligence sensor suite ground test bed to emulate an airborne moving platform. Perform risk reduction efforts for airborne implementations. Conduct radar systems engineering support fostering the transition of developed enabling technologies and concepts to weapon systems and ISR assets. Initiate integrated electronic support measures (ESM)/passive radar concept for enhanced target detection and tracking. Initiate development program for threat analysis/mitigation of passive multistatic, multi-intelligence sensing.			
(U) In FY 2007: Continue demonstration of the RF sensors of an integrated EO/RF sensor suite for UAVs with severe size, weight, and power constraints, to enable single platform persistent ISR capability compatible with a system of systems architecture. Develop highly integrated receiver-aperture technologies for improved functionality and greatly reduced size, weight, and power. Continue experiments with the ground test bed providing input into a design for an airborne multi-intelligence experiment. Continue radar systems engineering support fostering the transition of developed enabling technologies and concepts to weapon systems and ISR assets. Further develop an integrated ESM/passive radar concept for enhanced target detection and tracking. Develop program for threat analysis/mitigation of passive multistatic, multi-intelligence sensing.			
(U)			
(U) MAJOR THRUST: Develop weapons guidance quality track radar performance in advanced jamming environments. Develop and demonstrate advanced radar signal processing techniques to mitigate clutter and jamming interference, and improve detection and tracking of difficult targets in hostile environments.	0.377	0.512	1.116
(U) In FY 2005: Evaluated advanced radar techniques, sub-systems, and methods to establish and maintain weapons guidance quality track radar performance in advanced jamming environment. Validated and tested high fidelity fire control radar and weapon system simulation model to evaluate system and sub-system requirements and performance.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 665A Advanced Aerospace Sensors Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Demonstrate and evaluate adaptive processing techniques for multi-mission conformal arrays and wideband and polarization adaptive processing techniques for multi-function radar. Implement novel space-time adaptive processing techniques that are robust to heterogeneous data. Develop multi-sensor waveform transmission and signal processing techniques on selected advanced computing architectures			
(U)	In FY 2007: Demonstrate and evaluate novel space-time adaptive processing techniques that are robust to heterogeneous data. Demonstrate and evaluate multi-sensor waveform transmission and signal processing techniques on selected advanced computing architectures			
(U)				
(U)	CONGRESSIONAL ADD: Phase Diversity - Imaging Through Volume Turbulence.	1.100	0.000	0.000
(U)	In FY 2005: Investigated current operational slant and horizontal-path imaging scenarios to determine the impact of turbulence on operational performance. Extended the Phase-Diverse Speckle (PDS) algorithm to improve performance in the volume-turbulence imaging scenario. Conducted simulations to evaluate candidate algorithmic approaches. Investigated strategies for increased efficiencies in the PDS algorithm implementation to achieve near-real-time processing. Conducted a data collection to benchmark improvement in imaging quality in the volume-turbulence imaging scenario.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Testbed for Accelerated Transition - Advanced Multi-Discriminant Sensing.	1.000	0.000	0.000
(U)	In FY 2005: Developed an indoor laser radar (LADAR) test bed facility to test, characterize, and demonstrate advanced multi-mode LADARs. Established an initial capability for vibration LADAR.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	12.489	12.913	14.492

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603205F, Flight Vehicle									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603203F Advanced Aerospace Sensors**	PROJECT NUMBER AND TITLE **665A Advanced Aerospace Sensors Technology**

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

Technology.

(U) PE 0603707F, Weather Systems Advanced Development.

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.

(U) PE 0602111N, Weapons Technology.

(U) PE 0602232N, Space and Electronic Warfare (SEW) Technology.

(U) PE 0604249F, LANTIRN Night Precision Attack.

(U) PE 0603270F, Electronic Combat Technology.

(U) A Memorandum of Agreement has been established between Air Force Research Laboratory and Defense Advanced Research Projects Agency to jointly develop the technology required to detect high-value, time-critical targets in a variety of environments.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE: 69DF Target Attack and Recognition Technology	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
69DF	Target Attack and Recognition Technology	26.012	26.869	28.471	26.553	29.186	25.587	25.073	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced technologies for attack management, fire control, and target identification and recognition. This includes developing and demonstrating integrated and cooperative fire control techniques to provide for adverse-weather precision air strikes against multiple targets per pass and at maximum weapon launch ranges. Specific fire control technologies under development include attack management, sensor fusion, automated decision aids, advanced tracking for low radar cross section threats, and targeting using both on-board and off-board sensor information. This project also evaluates targeting techniques to support theater missile defense efforts in surveillance and attack. These fire control technologies will provide force multiplication and reduce warfighter exposure to hostile fire. This project also develops and demonstrates target identification and recognition technologies for positive, high confidence cueing, recognition, and identification of airborne and ground-based, high-value, time-critical targets at longer ranges than are currently possible. The goal is to apply these technologies to tactical air-to-air and air-to-surface weapon systems so they are able to operate in all weather conditions, during day or night, and in high-threat, multiple target environments. Model-based vision algorithms and target signature development techniques are the key to target identification and recognition. This project is maturing these technologies in partnership with the Defense Advanced Research Projects Agency, and evaluating the techniques to support theater missile defense efforts in surveillance and attack. Fire control and recognition technologies developed and demonstrated in this project are high leverage efforts, providing for significant advancements in operational capabilities largely through software improvements readily transitionable to new and existing weapon systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop modeling and simulation to show enhanced global awareness and precision engagement capability for warfighters. Note: Efforts complete in FY 2005.	1.411	0.000	0.000
(U) In FY 2005: Analyzed enhanced capability to find and identify time-critical targets using automated target recognition processing in a distributed common ground station. Completed an analysis of an enhanced capability to find and track targets under trees and camouflage by employing foliage penetration radar and automated sensor fusion technologies. Developed and employed air and ground target signature generation models to support automated target signature exploitation in automatic target recognizer and multi-sensor fusion algorithms. Generated synthetic target and scene signatures for automated signature exploitation of radio frequency (RF) and electro-optical (EO) sensor data. Analyzed advanced ground target signature generation methods.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop common open system technology integration for real-time information in- and	1.639	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 69DF Target Attack and Recognition Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	out-of-the-cockpit to improve aircrew combat and joint battlespace situational awareness, target nomination, and target engagement capabilities. Note: Efforts complete in FY 2005.			
(U)	In FY 2005: Integrated and flight-tested common situational awareness technology equipment suite on representative special operations aircraft to assess integrated system performance capabilities, aircrew workload reduction, and product maturity levels. Developed a laboratory incremental technology product approach to match transition of common situational awareness system components with special operations user acquisition resources for both fixed-wing and vertical lift aircraft.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop and test an automatic target recognition (ATR) system for tracking and identifying moving and stationary ground targets for use in strike and reconnaissance platforms.	2.113	5.107	4.019
(U)	In FY 2005: Finalized transition plans for advanced stationary target identification techniques and algorithms developed in the laboratory with synthetic aperture radar processing. Analyzed requirements and affordable risk reduction for transition of advanced moving target classification and identification techniques and algorithms via planned sensor upgrades to strike and reconnaissance platforms. Developed advanced moving target classification and identification techniques and algorithms for integration with high range resolution radar and other moving target indication processing techniques.			
(U)	In FY 2006: Develop radar-based air-to-ground moving target algorithm for tactical and reconnaissance platforms. Continue analysis and identification of legacy systems hardware/software upgrades required for algorithm transition to strike and reconnaissance platforms.			
(U)	In FY 2007: Perform a laboratory demonstration of a radar based air-to-ground moving target algorithm for tactical and reconnaissance platforms. Refine this capability for integration into candidate radar systems and platform specific product development roadmaps. Provide transition plans of the moving target algorithm technology to operational strike and reconnaissance platforms.			
(U)				
(U)	MAJOR THRUST: Develop and assess multi-sensor ATR for Air Force intelligence, surveillance, and reconnaissance (ISR); strike; and weapon systems.	4.564	5.635	5.596
(U)	In FY 2005: Assessed the performance of Air Force and Defense Advanced Research Projects Agency (DARPA) multi-sensor ATR fusion algorithms using the Air Force ATR evaluation test facility for application to Air Force ISR, strike, and weapon systems. Characterized both single and multiple sensor contributions from radar and EO, including hyperspectral imaging sensors with automated exploitation. Automated data collection planning for			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 69DF Target Attack and Recognition Technology

(U) B. Accomplishments/Planned Program ($ in Millions) FY 2005 FY 2006 FY 2007

transition (database development and upgrade) of algorithms. Improved ATR research and development (R&D) computer and networking infrastructure via software, hardware, and network integration enhancements. Improved processing capabilities and the expansion of the Department of Defense-wide repository for R&D sensor data. Developed an integrated computational and collaborative environment to accelerate the transition of ATR and sensor fusion technologies. Developed synthetic data generation capability to augment and enhance existing R&D and operational data sets. Showed impact of automated multi-sensor ATR and fusion capability in terms of timeline reduction for time-critical targeting to image analysts and decision-makers in the experimental Air Operations Centers.

(U) In FY 2006: Further assess the performance of Air Force and DARPA multi-sensor ATR fusion algorithms using the Air Force ATR evaluation test facility for application to Air Force ISR, strike, and weapon systems. Further characterize both single and multiple sensor contributions from radar and EO, including hyperspectral imaging sensors with automated exploitation. Complete the automation of data collection planning for transition of algorithms. Complete the initial ATR R&D computer and networking infrastructure via software, hardware, and network integration enhancements. Complete the initial processing capabilities and the on-line DoD-wide repository for R&D sensor data. Complete the on-line integrated computational and collaborative environment to accelerate the transition of ATR and sensor fusion technologies. Further develop synthetic data generation capability to augment and enhance existing R&D and operational data sets. Further assess impact of automated multi-sensor automatic target recognition and fusion capability in terms of timeline reduction for time-critical targeting to image analysts and decision-makers in the experimental Air Operations Centers. Initiate the modeling of platform and sensor systems in simulated operational environments. Initiate assessment of moving target tracking and identification approaches for multiple sensor types. Initiate evaluation of automated exploitation and rapid response technology enhancements for post-conflict force protection, stability, and security operations.

(U) In FY 2007: Continue to assess the performance of Air Force and DARPA multi-sensor ATR fusion algorithms using the Air Force ATR evaluation test facility for application to Air Force ISR, strike, and weapon systems. Continue characterizing both single and multiple sensor contributions from radar and EO, including hyperspectral imaging sensors with automated exploitation. Collect, process, archive, and distribute R&D sensor data for automated exploitation technology development and assessment. Support automated exploitation technology development and assessment with collaborative computing environment. Complete development of synthetic data generation capability to augment collected R&D and operational data sets. Augment the Department of Defense-wide repository of R&D sensor data with multi-sensor imagery and tracking data collected at warfighter-sponsored exercises. Continue to show impact of automated multi-sensor ATR and fusion capability in terms of timeline reduction for time-critical targeting to image analysts and decision-makers in the experimental Air

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 69DF Target Attack and Recognition Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Operations Centers. Initiate modeling of existing and emergent sensor systems for assessing automated exploitation technologies in simulated operational environments. Continue assessment of moving target tracking and identification approaches for multiple sensor types. Initiate evaluation of technology enhancements for post-conflict force protection, stability, and security operations.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate a moderate confidence ATR and advanced cueing capability for stationary and moving targets.	1.858	3.528	9.303
(U)	In FY 2005: Performed critical experiments based upon results from studies and analyses of which combination of sensors, modes, and fusion processing techniques would provide combat identification of the highest confidence. Performed engineering-level analyses and critical experiments to determine what sensor technologies and fusion techniques may provide a near-term combat identification capability of the highest confidence achievable. Carried out a technology demonstration effort of promising near-term sensor technologies and fusion processing techniques. Conducted characterization studies of advanced stationary and moving target radar data to determine its utility for automatic target recognition and advanced cueing (ATR/C) and combat identification. Refined tool development to support sensor system, sensor management, and system performance analyses. Performed advanced multi-sensor data collections on stationary and moving targets.			
(U)	In FY 2006: Continue developing high confidence combat identification capability to determine which combination of sensors, modes, and fusion processing techniques provide a high confidence combat identification capability for stationary and moving ground targets. Initiate critical experiments to refine high-level, near-term fusion processes. Continue characterization studies of advanced stationary and moving target radar data to determine utility for ATR/C and combat identification. Start a technology demonstration effort of promising near-term, multi-sensor technologies and fusion processing techniques. Continue analyses and characterization studies for advanced, multi-sensor, multi-platform fusion processing techniques. Refine tool development to support sensor system, sensor management, and system performance analyses. Perform advanced multi-sensor data collection(s) on stationary and moving targets.			
(U)	In FY 2007: Further develop high confidence combat identification capability to determine which combination of sensors, modes, and fusion processing techniques provide a high confidence combat identification capability for stationary and moving ground targets. Further the technology demonstration effort of promising near-term, multi-sensor technologies and fusion processing techniques. Continue critical experiments of advanced multi-sensor, multi-platform technologies and fusion processing techniques for strike and ISR assets. Further characterize studies of advanced stationary and moving target multi-sensor data to determine utility for ATR/C and combat identification. Further refine tool development to support sensor system, sensor management, and system performance analyses.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 69DF Target Attack and Recognition Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Continue advanced multi-sensor data collection(s) on stationary and moving targets.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate an ATR capability integrated with advanced georegistration techniques and innovative change detection algorithms.	2.927	5.508	3.569
(U)	In FY 2005: Integrated ATR/C, georegistration, and change detection techniques. Demonstrated initial integrated time-critical targeting capability leveraging the advanced real-time contingency cell, the Targets Under Trees program products and the technology developments associated with DARPA's Dynamic Tactical Targeting program.			
(U)	In FY 2006: Complete integration and field test of ATR/C, georegistration, and change detection techniques. Continue to utilize the advanced recognition capability test bed to integrate and upgrade time-critical targeting (TCT) capability and support transition to the warfighter. Complete integration and field testing of a capability that continuously tracks TCTs and reduces the kill chain through a reduction in strike platforms target acquisition time. Begin design and development of an autonomous multi-sensor management and data exploitation system supporting an all-weather mission for tactical platforms, including unmanned aerial vehicles (UAVs). Initiate critical experiments to investigate concealed target identification (ID) phenomenology. Continue data collection, modeling, and analysis for ID sensors, platforms, and concept of operations.			
(U)	In FY 2007: Continue to utilize the advanced recognition capability test bed to integrate and upgrade TCT capability to support the transition to the warfighter of technology products that detect concealed targets and improve ability to dynamically track TCTs. Continue development of an autonomous multi-sensor management and data exploitation system supporting an all-weather mission for tactical platforms, including UAVs. Initiate design and conduct concept demonstration of a concealed target ID sensor and exploitation capability. Initiate the development of an advanced tracking capability that utilizes advanced radar features to fingerprint and associate vehicle observations and integrates multiple radar sensors to maintain continuous track through difficult terrain and in dense traffic.			
(U)				
(U)	MAJOR THRUST: Develop Identify Friend, Foe, or Neutral air-to-ground capability using cooperative and non-cooperative identification techniques. Note: This work is an outgrowth of other work within this project.	0.000	1.966	5.984
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct design studies to develop technologies to improve the performance of ATR and combat ID systems used to sort friend/foe/neutral entities during air-to-ground attack of stationary and moving ground vehicles. Studies will include ground target database enhancements, advanced algorithms for non-cooperative ID of moving targets, and RF tags for cooperative target ID. Define techniques to make ground target databases more robust and affordable for application using multiple sensors, for operation using real or synthetic data, and for modeling denied targets. Develop advanced algorithms to closely couple tracking with ID functions, exploit unique RF			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 69DF Target Attack and Recognition Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	phenomenology, and integrate cooperative and non-cooperative ID methods. Assess RF tag systems versus warfighter requirements to define a system architecture, define techniques to assure secure data exchange without threat of exploitation, and define interfaces for cross-S ervice or coalition interoperability.			
(U)	In FY 2007: Finalize design studies and initiate critical experiments to verify improved ground target ID capabilities resulting from ground target database enhancements, ID algorithm enhancements, and advanced RF tags. Refine advanced ID algorithms and laboratory test with operational sensor data to measure improved confidence/reliability of target ID. Finalize RF tag design and conduct simulation testing to confirm improved pilot/system operator situation awareness, verify friendly ID confirmations, and perform initial interoperability assessments. Improve exploitation tools to allow automatic screening large volumes of ISR imagery. Develop technology for wide area detection, tracking, and ID against difficult, asymmetric targets at long range. Develop and integrate emerging technologies to enable small UAVs with EO/IR sensors to provide persistent ISR.			
(U)				
(U)	CONGRESSIONAL ADD: National Operational Signature Production and Research Capability.	11.500	5.125	0.000
(U)	In FY 2005: Refined the signature modeling and simulation capability for database production support to critical combat identification systems. Broadened enhancements to the target and threat radar signature prediction codes and tools to support a deployed non-cooperative combat identification system.			
(U)	In FY 2006: Conduct Congressionally-directed effort for National Operational Signature Production and Research Capability.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	26.012	26.869	28.471

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603253F, Advanced Sensor Integration.									
(U) PE 0603500F, Multi-Disciplinary Advanced Space Technology.									

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BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603203F Advanced Aerospace Sensors**	PROJECT NUMBER AND TITLE **69DF Target Attack and Recognition Technology**

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

(U) PE 0603762E, Sensor and Guidance Technology.

(U) PE 0603270F, Electronic Combat Technology.

(U) Theater Missile Defense System Program Office.

(U) Low Altitude Night Targeting and Infrared Navigation (LANTIRN) System Program Office.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **03 Advanced Technology Development (ATD)**

PE NUMBER AND TITLE: **0603203F Advanced Aerospace Sensors**

PROJECT NUMBER AND TITLE: **88SP Advanced Space Sensors**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
88SP Advanced Space Sensors	0.000	0.000	12.187	12.959	13.044	8.036	8.183	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts will transfer from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5034, Advanced Space Sensors, to this project in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates space sensor technologies, including radio frequency sensors; intelligence, surveillance, and reconnaissance sensors (ISR); electro-optical sensors; laser warning sensors; targeting and attack radar sensors; and electronic counter-countermeasures (ECCM) and communications. By developing multi-function radar, laser, electronic combat, and ECCM technologies for space applications, this project provides space platforms with the capability to precisely detect, track, and target air- and ground-based, high-value, time-critical targets, while remaining invulnerable to hostile and natural threats.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Reduce technology risk for space sensor platform payload components and exploitation of infrastructure integration.	0.000	0.000	0.756
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Integrate space-sensor technologies into a complete radar payload simulation test bed with selected hardware in the loop and demonstrate system design feasibility.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate technologies to maximize Global Positioning System (GPS) jam resistance, positional accuracy, timing accuracy, and exploitation techniques to improve offensive and defensive combat capabilities.	0.000	0.000	1.540
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Develop space-based distributed position, navigation, and timing technologies to achieve optimal sensor fusion for a common operational picture. Develop multi-ship virtual flight test simulation technology to assess networked clusters of "mini" unmanned aerial vehicles, ISR platforms, and space-based platforms.			
(U)			
(U) MAJOR THRUST: Develop space laser warning sensor technologies for timely alert to advanced laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low-power (laser-guided ordnance) signals.	0.000	0.000	2.282
(U) In FY 2005: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 88SP Advanced Space Sensors

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Flight demonstration of false alarm package space-flight components. Initiate on-orbit testing, data collection, and system evaluation with false alarm phenomenology suite. Initiate fabrication of advanced space-qualified laser warning sensors for rapid detection and characterization of laser designators, trackers, dazzlers, and weapons. Initiate testing with space-based laser threat scenario testbed for satellite-as-a-sensor technology evaluations.			
(U)				
(U)	MAJOR THRUST: Develop advanced laser communication component and sub-system technology to support a network-level topology for Airborne ISR.	0.000	0.000	5.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Begin development of an integrated wideband radio frequency (RF)/electro-optical (EO) communication terminal and shared aperture antenna for evaluation and testing in an air network layer. Continue development of technologies for shared RF/EO apertures to service high bandwidth communication needs. Continue testing applicability of shared apertures to maintaining air network link connectivity under in weather conditions. Expand flight demonstrations of air network layer technologies RF, optical and combined RF/optical communication terminals.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate geodesic phased array antenna to achieve enhanced satellite operations over current reflector antennas. Improve operational capacity and efficiency to support satellite control network.	0.000	0.000	2.609
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Analyze system requirements and complete the design of the multi-beam geodesic dome antenna. Finalize RF and mechanical designs of the geodesic dome panels to demonstrate critical performance characteristics. Complete evaluation of the transmit/receive modules, the radiating element, beamformer array panels, and the antenna resource manager computer.			
(U)				
(U)	Total Cost	0.000	0.000	12.187

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 88SP Advanced Space Sensors

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602204F, Aerospace Sensors.

(U) PE 0602500F, Multi-Disciplinary Space Technology.

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.

(U) PE 0603270F, Electronic Combat Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0603211F
PE TITLE: Aerospace Technology Dev/Demo

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603211F Aerospace Technology Dev/Demo

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	34.717	53.657	27.424	57.925	114.655	117.057	122.232	Continuing	TBD
486U	Advanced Aerospace Structures	12.341	28.882	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
4920	Flight Vehicle Tech Integration	22.376	24.775	24.624	57.090	114.189	116.564	118.718	Continuing	TBD
99SP	Advanced Structures Space Vehicles	0.000	0.000	2.800	0.835	0.466	0.493	3.514	Continuing	TBD

Note: In FY 2006, efforts from Project 486U transfer into Project 4920 within this PE. Funds for the FY 2006 Congressionally-directed National Aerospace Leadership Initiative in the amount of $20.7 million are in the process of being moved to PE 0601102F, Defense Research Sciences, from PE 0603211F, Aerospace Technology Dev/Demo, for execution. Funds for the FY 2006 Congressionally-directed Next Generation Helmet Tracking and Display Technology in the amount of $0.986 million are in the process of being moved to PE 0603231F, Crew Systems and Personal Protection Technology, from PE 0603211F, Aerospace Technology Dev/Demo, for execution. Funds for the FY 2006 Congressionally-directed Hybrid Radio Frequency - Optical Communications Terminal in the amount of $0.986 million are in the process of being moved to PE 060789F, C3I Advanced Development, from PE 0603211F, Aerospace Technology Dev/Demo, for execution. Funds for the FY 2006 Congressionally-directed Design Manual for Titanium Honeycomb Sandwich Composite in the amount of $3.253 million are in the process of being moved to PE 0603211F, Aerospace Technology Dev/Demo from PE 0603112F, Advanced Materials for Weapon Systems, for execution. In FY 2007, Project 6399SP, Advanced Structures for Space Vehicles, efforts were transferred from PE 0603500F, Multidisciplinary Advanced Space Technology, Project 635062, Advanced Structures for Space Vehicles, order to effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This program demonstrates advanced aerospace vehicle technologies. Advanced aerospace structures are demonstrated to sustain and enhance the capability of current and future aerospace vehicles, such as a next generation bomber. Flight vehicle technology integration is accomplished through integration of various technologies to include avionics, advanced propulsion, and weapon systems for demonstration in near-realistic operational environments. Note: In FY 2006, Congress added $4.2 million for Capabilities Planning Support Phase 2, $2.1 million for Fly-By-Light, $1.0 million for Hybrid Radio Frequency - Optical Communications Terminal, $1.0 million for Next Generation Helmet Tracking and Display Technology, and $21.0 million for National Aerospace Leadership Initiative. This program is in the Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing aerospace vehicle system upgrades and/or new system developments that have military utility and address warfighter needs.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	38.602	25.133	24.345
(U)	Current PBR/President's Budget	34.717	53.657	27.424
(U)	Total Adjustments	-3.885	28.524	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.029	-0.776	
	Congressional Increases		29.300	
	Reprogrammings	-2.848		
	SBIR/STTR Transfer	-1.008		

(U) Significant Program Changes:

Not Applicable.

(U) C. Performance Metrics

Under Development

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **03 Advanced Technology Development (ATD)**

PE NUMBER AND TITLE: **0603211F Aerospace Technology Dev/Demo**

PROJECT NUMBER AND TITLE: **486U Advanced Aerospace Structures**

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
486U	Advanced Aerospace Structures	12.341	28.882	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, efforts from Project 486U transfer into Project 4920 within this PE. Funds for FY2006 Congressionally-directed National Aerospace Leadership Initiative in the amount of $20.7 million are in the process of being moved to PE 0601102F, Defense Research Sciences, from PE 0603211F, Aerospace Technology Dev/Demo, for execution. Funds for the FY 2006 Congressionally-directed Next Generation Helmet Tracking and Display Technology in the amount of $0.986 million are in the process of being moved to PE 0603231F, Crew Systems and Personal Protection Technology, from PE 603211F, Aerospace Technology Dev/Demo, for execution. Funds for the FY 2006 Congressionally-directed Hybrid Radio Frequency - Optical Communications Terminal in the amount of $0.986 million are in the process of being moved to PE 060789F, C3I Advanced Development, from PE 0603211F, Aerospace Technology Dev/Demo, for execution. Funds for the FY 2006 Congressionally-directed Design Manual for Titanium Honeycomb Sandwich Composite in the amount of $3.253 million are in the process of being moved to PE 0603211F, Aerospace Technology Dev/Demo, from PE 0603112F, Advanced Materials for Weapon Systems, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates affordable aerospace vehicle technologies to sustain the existing fleet, reduce the cost of aircraft ownership, and enhance the capability of current and future aerospace vehicles. Sustainment of the existing fleet through extended operational service life with innovative technology application will lead to reduced operations and support costs, and increased operational readiness. Analytical certification will reduce the cost associated with component replacement by allowing and certifying new designs under reduced test requirements. Development of capability enhancing technologies will expand the operational envelope and increase survivability in high threat environments. Demonstration of these technologies will restore structural integrity, extend structural life, enhance the capability, and reduce the life cycle costs of fielded aircraft.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate technologies related to improved munitions separation enhancement and acoustic reduction in current and future aircraft. Note: In FY 2006, this effort was the only remaining effort in Project 486U and was transferred back to Project 4920 within this PE.	3.373	0.000	0.000
(U) In FY 2005: Continued to develop active flow control devices to significantly increase and expand the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage at speeds in excess of Mach 1.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) CONGRESSIONAL ADD: Three-Dimensional Bias Woven Preforms Development Program.	1.839	0.000	0.000
(U) In FY 2005: Continued Congressionally-directed effort for Three-Dimensional Bias Woven Preforms Development Program.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603211F Aerospace Technology Dev/Demo**	PROJECT NUMBER AND TITLE **486U Advanced Aerospace Structures**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Capabilities Planning Support. Note: In FY 2005, two Congressional Adds were appropriated for this effort; both are being managed as a single effort.	6.191	4.140	0.000
(U)	In FY 2005: Initiated Congressionally-directed effort for capabilities planning support.			
(U)	In FY 2006: Continue Congressionally directed effort for capabilities planning support.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Haleakala Laser Communications Testbed.	0.938	0.000	0.000
(U)	In FY 2005: Initiated Congressionally-directed effort for Haleakala laser communication testbed.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Fly-By-Light.	0.000	2.070	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Continued Congressionally-directed effort for fly-by-light.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Hybrid Radio Frequency - Optical Communications Terminal.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Initiate Congressionally-directed effort for hybrid radio frequency - optical communications terminal.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Next Generation Helmet Tracking and Display Technology.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Initiated Congressionally-directed effort for next generation helmet tracking and display technology.			
(U)	In FY 2007: Not Applicable.			
(U)	CONGRESSIONAL ADD: National Aerospace Leadership Initiative.	0.000	20.700	0.000
(U)	In FY 2005: Initiated this Congressionally-directed effort in PE 0601102F, Defense Research Sciences.			
(U)	In FY 2006: Continue Congressionally-directed effort for national aerospace leadership initiative.			
(U)	In FY 2007: Not Applicable.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603211F Aerospace Technology Dev/Demo**	PROJECT NUMBER AND TITLE **486U Advanced Aerospace Structures**

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
(U) Total Cost	12.341	28.882	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602201F, Aerospace Vehicle Technologies.

(U) PE 0604015F, Next Generation Bomber.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603211F Aerospace Technology Dev/Demo	PROJECT NUMBER AND TITLE: 4920 Flight Vehicle Tech Integration	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4920 Flight Vehicle Tech Integration	22.376	24.775	24.624	57.090	114.189	116.564	118.718	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, efforts from Project 486U transfer into Project 4920 within this PE.

(U) A. Mission Description and Budget Item Justification

This project integrates and demonstrates advanced flight vehicle technologies that will improve the performance and supportability of existing and future manned and unmanned aerospace vehicles. System level integration brings together the aerospace vehicle technologies along with avionics, propulsion, and weapon systems for demonstration in a near-realistic operational environment. Integration and technology demonstrations reduce the risk and time required to transition technologies into operational aircraft. This program provides proven aerospace vehicle technologies for all-weather, day/night operations with improved performance and affordability.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop autonomous flight controls for safe flight operations between manned and unmanned air platforms.	8.054	7.201	5.239
(U) In FY 2005: Developed and demonstrated control automation techniques, components, and algorithms to enable the safe and inter operable application of unmanned vehicle systems. Completed the integration and test of key autonomous control component technologies. Demonstrated fully integrated, adaptive, fault tolerant, autonomous control system suite to provide significantly increased reliability and mission effectiveness for unmanned vehicle systems. Demonstrated key photonic sensing and control elements for flight critical control.			
(U) In FY 2006: Complete hardware-in-the-loop simulation assessments of integrated, adaptive, fault tolerant, autonomous control system suite to verify significantly increased reliability and mission effectiveness for unmanned vehicle systems. Complete environmental testing of key photonic sensing and control elements for flight critical control. Prepare key photonic sensing and control elements for flight-testing. Flight demonstrate automated see and avoid capability for unmanned air vehicles.			
(U) In FY 2007: Complete ground simulation and flight demonstration of key hardware and software systems for adaptive, fault tolerant, autonomous unmanned air vehicle airborne control. Initiate development of situational awareness and control technologies for automated airbase ground operations for unmanned air vehicles.			
(U)			
(U) MAJOR THRUST: Develop an Automated Aerial Refueling capability for unmanned and manned air platforms. Note: In FY 2005, Automated Aerial Refueling efforts described in the autonomous flight controls thrust area were broken out to allow for increased visibility for this effort.	4.698	0.000	0.000
(U) In FY 2005: Completed development of automated aerial refueling sensing, communication, and control algorithm components. Completed integration, simulation, and analysis verifying safe autonomous operation in proximity of			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo	PROJECT NUMBER AND TITLE 4920 Flight Vehicle Tech Integration

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
manned tankers. Conducted flight demonstrations of initial automated aerial refueling capability for unmanned aerial vehicles using existing fleet tankers, operational procedures, and unmanned combat air vehicles.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop, simulate, and demonstrate integrated technologies to improve the performance of manned and unmanned platforms. Note: The FY 2006 increase in funding is the direct result of incorporating the remaining effort from Project 486U into this thrust. The FY 2007 decrease is due to completion of a majority of the thrust objectives in FY 2006.	3.132	6.149	1.443
(U) In FY 2005: Developed advanced aerodynamic/structural integration concepts to enable increased system performance at reduced cost. Demonstrated an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles.			
(U) In FY 2006: Complete initial demonstration of an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. Continue demonstration of active flow control devices to significantly increase and expand the separation envelope for miniature munitions and reduce weapon bay acoustics to minimize damage to the aircraft at speeds in excess of Mach 1.			
(U) In FY 2007: Continue development of a simulation environment to enable evaluation of network centric technologies for improved capabilities for high speed operational concepts.			
(U)			
(U) MAJOR THRUST: Develop analytical certification methods and capability to reduce the need for physical testing in the certification of structural components resulting in reduced acquisition cost for new systems and reduced support costs for future and legacy systems. Demonstrate reduced support costs for future systems by incorporation of advanced monitoring capabilities. Note: Funding increase is due to increased emphasis being placed on diagnostic and prognostic health monitoring tool development for future aircraft systems.	0.452	3.475	8.704
(U) In FY 2005: Developed improved sustainment technologies for existing aging aircraft and future aerospace vehicle structures to reduce operations and support costs and extend usable structural lives. Developed real-time diagnostic and prognostics health monitoring tools of thermal protection systems, tanks, structures, and subsystems to enable rapid turn around and high temperature operations. Completed the demonstration of approaches to reliably use virtual and analytical methods to substantially reduce the need for physical testing in the certification of structural components resulting in reduced acquisition cost for new systems and reduced support costs for legacy systems.			
(U) In FY 2006: Continue development and initiate demonstration of improved sustainment technologies for existing aging aircraft and future aerospace vehicle structures to reduce operations and support costs and extend usable			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo	PROJECT NUMBER AND TITLE 4920 Flight Vehicle Tech Integration

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	structural lives. Continue development and initiate demonstration of real-time diagnostic and prognostics health monitoring tools for thermal protected systems, tanks, structures, and subsystems to enable rapid turn around and high temperature operations of high-speed aircraft.			
(U)	In FY 2007: Continue demonstration of improved sustainment technologies for existing aging aircraft and future aerospace vehicle structures to reduce operations and support costs and extend usable structural lives. Continue demonstration of real-time diagnostic and prognostics health monitoring tools for thermal protected systems, tanks, structures, and subsystems to enable rapid turn around and high temperature operations.			
(U)				
(U)	MAJOR THRUST: Develop aircraft structures that have embedded components, which have previously been separate components that were attached to the air platforms.	3.803	4.378	6.173
(U)	In FY 2005: Continued development of multi-functional integrated structures to reduce acquisition and support costs, weight, and volume and increase performance of air vehicles. Completed demonstration of concepts with high multi-element antenna arrays embedded in load-bearing structure to increase antenna performance improvement and reduced vehicle weight, cost, and volume. Continued development of concepts of very large, low frequency antenna arrays embedded in load-bearing structure to enable new antenna capabilities and increased performance, while reducing vehicle weight, cost, and volume.			
(U)	In FY 2006: Continue development of multi-functional integrated structures to reduce acquisition and support costs, weight, and volume and increase performance of air vehicles. Initiate flight demonstration of concepts with high multi-element antenna arrays embedded in load-bearing structure to increase antenna performance improvement and reduced vehicle weight, cost, and volume. Continue development and initiate demonstration of concepts for very large, low frequency antenna arrays embedded in the aircraft load-bearing structure to enable new antenna capabilities and increased performance, while reducing vehicle weight, cost, and volume.			
(U)	In FY 2007: Continue and assess results from flight demonstration of concepts with high multi-element antenna arrays embedded in load-bearing structure to increase antenna performance improvement and reduced vehicle weight, cost, and volume. Continue demonstration of concepts for very large, low frequency antenna arrays embedded in load-bearing structure to enable new antenna capabilities and increased performance, while reducing vehicle weight, cost, and volume.			
(U)				
(U)	MAJOR THRUST: Develop adaptive structures to provide in-flight modifications offering improved performance over a wide range of flight conditions and mission profiles.	2.237	3.572	3.065
(U)	In FY 2005: Developed integrated thermal airframe structures, including thermal protection systems, attachments, seals, joining technologies, hot primary structure, and structural health monitoring for high speed vehicle			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo	PROJECT NUMBER AND TITLE 4920 Flight Vehicle Tech Integration

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	applications.			
(U)	In FY 2006: Continue development and initiate demonstration of integrated thermal airframe structures including thermal protection systems, attachments, seals, joining technologies, hot primary structure, and structural health monitoring for high-speed vehicle applications. Continue development and initiate demonstration of highly efficient wing concepts integrating active aeroelastic design concepts, adaptive structures, and aerodynamic flow control technologies to enable viable long-range and long-endurance air vehicle concepts.			
(U)	In FY 2007: Further refine integrated thermal airframe structures including thermal protection systems, attachments, seals, joining technologies, hot primary structure, and structural health monitoring for high-speed vehicle applications. Continue development and demonstration of highly efficient wing concepts integrating active aeroelastic design concepts, adaptive structures, and aerodynamic flow control technologies to enable viable long range and long endurance air vehicle concepts.			
(U)				
(U)	Total Cost	22.376	24.775	24.624

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602201F, Aerospace Vehicle Technologies.

(U) PE 0604015F, Next Generation Bomber.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603211F Aerospace Technology Dev/Demo

PROJECT NUMBER AND TITLE: 99SP Advanced Structures Space Vehicles

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
99SP Advanced Structures Space Vehicles	0.000	0.000	2.800	0.835	0.466	0.493	3.514	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, Project 6399SP, Advanced Structures for Space vehicles, efforts were transferred from PE 0603500F, Multidisciplinary Advanced Space Technologies, Project 635062, Advanced Structures for Space Vehicles, in order to effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project identifies, develops, and demonstrates the technologies to enable advanced access-to-space aerospace vehicles that deliver revolutionary capability, operability, responsiveness, and cost-effectiveness. Enabling technologies include thermal protection, structures, vehicle systems, configurations, aerodynamics, and controls. Technology demonstration includes multi-disciplinary system level integration of the enabling technologies.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop the airframe and payload technologies required to enable horizontal launch of reusable high altitude aerospace vehicles.	0.000	0.000	2.800
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Continue developing the airframe and payload technologies required to enable next generation reusable access to space systems including the thermal protection, structural, configuration, and vehicle and payload system technologies that enable aerospace vehicles to exhibit revolutionary capability, operability, responsiveness, and cost-effectiveness.			
(U) Total Cost	0.000	0.000	2.800

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602201F, Aerospace Vehicle Technology									

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

(U) D. Acquisition Strategy

Not Applicable.

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

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

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

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	76.110	97.163	115.546	119.310	128.770	134.887	137.886	Continuing	TBD
10SP	Space Rocket Prop Demo	0.000	0.000	27.858	29.597	34.410	38.574	39.766	0.000	0.000
2480	Aerospace Fuels	0.345	0.193	2.868	4.811	5.237	5.344	5.442	Continuing	TBD
3035	Aerospace Power Technology	4.701	8.702	5.652	6.135	4.613	4.707	4.796	Continuing	TBD
4921	Aircraft Propulsion Subsystems Int	21.026	32.953	14.334	25.149	27.261	27.828	28.350	Continuing	TBD
4922	Space & Missile Rocket Propulsion	5.200	8.011	4.839	4.859	5.272	5.382	5.484	Continuing	TBD
5098	Advanced Aerospace Propulsion	23.004	22.882	34.167	22.832	23.838	24.331	24.789	Continuing	TBD
681B	Advanced Turbine Engine Gas Generator	21.834	24.422	25.828	25.927	28.139	28.721	29.259	Continuing	TBD

Note: In FY 2005-2007, a portion of the funding in Projects 2480 and 4921 was shifted to Project 5098. In FY 2007, Project 310SP, Space Rocket Propulsion Demonstration, will transfer from PE 0603500F, Multi-Disciplinary Advanced Development Space Technology, Project 5033, Rocket Propulsion Demonstration, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to achieve enabling and revolutionary advances in turbine, advanced cycle, and rocket propulsion, as well as power generation and storage, and fuels. The program has six projects, each focusing on technologies with a high potential to enhance the performance of existing and future Air Force weapons systems. The Aerospace Fuels and Atmospheric Propulsion project develops and demonstrates improved hydrocarbon fuels and advanced propulsion systems for high-speed/hypersonic flight. The Aerospace Power Technologies project develops and demonstrates power and thermal systems for weapons and aircraft. The Advanced Turbine Engine Gas Generator (ATEGG) project develops and demonstrates core turbine engine technologies for current and future aircraft propulsion systems. The Aerospace Propulsion Subsystem Integration project integrates the engine cores demonstrated in the ATEGG project with low-pressure components into demonstrator engines. Turbine engine propulsion projects within this program are part of the Integrated High Performance Turbine Engine Technology and the Versatile Affordable Advanced Turbine Engine programs. The Advanced Aerospace Propulsion project develops the scramjet propulsion cycle to a technology readiness level appropriate for in-flight demonstration and for full integration with other engine cycles (including turbine and rocket based). Finally, the Space and Missile Rocket Technology project develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques. Rocket propulsion projects within this program are part of the Integrated High Payoff Rocket Propulsion Technology program, which includes the area of Technology for the Sustainment of Strategic Systems. Note: In FY 2006, Congress added $1.7 million for Advanced Satellite Thermal Control Program, $1.0 million for Field Renewable Energy System Hybrids (FRESH) Li Ion Battery Program, $2.1 million for More Electric Technology for Mission Critical Power Systems, $1.5 million for Solid Boost Power Technology, $6.0 million for VAATE (Versatile Affordable Advanced Turbine Engine) Advanced Supersonic Cruse Missile Engine, $1.2 million for Versatile Affordable Advanced Turbine Engine -- 5K-7K Trust Category, $6.8 million for Versatile Affordable Advanced Turbine Engine (Note: Only for the XTC 58F/1 Demonstrator Program), and $1.0 million for X-43C Development. 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.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	86.050	77.268	86.690
(U)	Current PBR/President's Budget	76.110	97.163	115.546
(U)	Total Adjustments	-9.940	19.895	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.066	-1.405	
	Congressional Increases		21.300	
	Reprogrammings	-7.699		
	SBIR/STTR Transfer	-2.175		
(U)	Significant Program Changes:			

Not Applicable.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **03 Advanced Technology Development (ATD)**

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

PROJECT NUMBER AND TITLE: **10SP Space Rocket Prop Demo**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
10SP Space Rocket Prop Demo	0.000	0.000	27.858	29.597	34.410	38.574	39.766	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts will transfer from PE 0603500F, Aerospace Propulsion and Power Technology, Project 5033, Space Rocket Propulsion Demonstration, to this Project in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced and innovative low-cost rocket turbomachinery and components, low-cost space launch propulsion system technologies, and advanced propellants for launch and orbit transfer propulsion. Additionally, this project develops technologies for the Technology for Sustainment of Strategic Systems Phase 1. Characteristics such as environmental acceptability, affordability, reliability, responsiveness, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. This project also develops chemical, electrical, and solar rocket propulsion system technologies for stationkeeping and on-orbit maneuvering applications. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion systems, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy propellants. Technological advances developed in this program could improve the performance of expendable systems' payload capabilities by approximately20 percent, and reduce launch, operations, and support costs by approximately 30 percent. Responsiveness and operability of propulsion systems will be enhanced for reusable launch systems. Technology advances could also lead to seven-year increase in satellite on-orbit time, a 50 percent increase in satellite maneuvering capability, a 25 percent reduction in orbit transfer operational costs, and a 15 percent increase in satellite payload. The efforts in this project contribute to the Integrated High Payoff Rocket Propulsion Technology program (IHPRPT), a joint Department of Defense, National Aeronautics and Space Administration, and industry effort to focus rocket propulsion technology on national space launch needs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch vehicles.	0.000	0.000	21.166
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Complete testing of advanced lightweight thrust chamber and nozzle technologies. Continue scale-up of advanced cryogenic upper stage technologies including higher efficiency energy conversion systems. Begin studies for advanced hydrocarbon engine technologies for future reusable launch vehicles.			
(U)			
(U) MAJOR THRUST: Develop solar electric propulsion technologies for existing and future satellites, upper stages, orbit transfer vehicles, and satellite formation flying, station keeping, and repositioning.	0.000	0.000	4.069
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Continue development of electric propulsion systems for orbit-transfer by developing high-power Hall			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 10SP Space Rocket Prop Demo

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	thrusters capable of Low Earth Orbit to Geosynchronous Orbit transfer. Begin component integration for the high-power Hall thruster demonstration. Complete support of test flight of the advanced small satellite propulsion demonstration unit for a microsatellite demonstration. Support test flight of propulsive attitude control system microsatellite demonstration. Initiate hardware scale-up for an advanced dual mode (high thrust or high efficiency) hybrid propulsion system for satellites. Continue development of technologies for satellite sensors to analyze satellite thruster interactions.			
(U)				
(U)	MAJOR THRUST: Develop electric and advanced chemical based monopropellant propulsion technologies for future satellite propulsion systems. Phases are referring to IHPRPT program phases.	0.000	0.000	2.623
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Initiate development of an advanced Phase III monopropellant thruster.			
(U)	Total Cost	0.000	0.000	27.858

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Not applicable.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

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

PROJECT NUMBER AND TITLE: 2480 Aerospace Fuels

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2480 Aerospace Fuels	0.345	0.193	2.868	4.811	5.237	5.344	5.442	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

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

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates improved hydrocarbon fuels and advanced, novel aerospace propulsion systems, including systems for high-speed/hypersonic flight and technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. The advanced fuel emphasis is on developing and demonstrating new thermally stable, high-heat sink, and controlled chemically reacting fuels for a conventional turbine engine, turbine-based combined cycle engines, and other advanced propulsion systems. The project also develops and demonstrates fuel system components that minimize cost, reduce maintenance, and improve performance of future aerospace systems. The advanced propulsion emphasis is on demonstrating concepts for combined cycle, ramjet, and scramjet engines. This project is integrated into the Versatile Affordable Advanced Turbine Engine program.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Demonstrate thermally stable fuels and fuel system hardware concepts to enhance cooling capacity (performance), minimize fuel coking, and reduce fuel system maintenance.	0.056	0.025	1.001
(U) In FY 2005: Conducted a study, test, and demonstration at a pilot-light level, of advanced high heat sink fuels and hardware concepts that can increase fuel delivery system durability and performance at high temperatures and reduce maintenance due to fuel degradation in an aircraft fuel system and engine control hardware.			
(U) In FY 2006: Continue to study, test, and demonstrate at a pilot-light level, advanced high heat sink fuels including those produced from alternative energy resources and hardware concepts that can increase engine performance at high temperatures, improve fuel system durability, and reduce maintenance due to fuel degradation in aircraft and engine hardware.			
(U) In FY 2007: Continue to study, test, and demonstrate, advanced high heat sink fuels including those produced from alternative energy resources and hardware concepts that can increase engine performance at high temperatures, improve fuel system durability, and reduce maintenance due to fuel degradation in aircraft and engine hardware. Initiate demonstrations of fuel performance at fuel temperatures in the supercritical regime.			
(U)			
(U) MAJOR THRUST: Determine fuel cooling requirements and specifications for advanced aircraft sensors and directed energy weapons that will meet the needs of evolving manned systems and unmanned aerial vehicle (UAVs).	0.136	0.025	0.506
(U) In FY 2005: Conducted pilot-light level demonstrations of low temperature additives for use in jet fuel to allow advanced manned and unmanned systems to sustain high altitude loiter for extended periods with focus on combustion performance of additized fuels			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 2480 Aerospace Fuels

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Continue, at a pilot-light level, to study, test, and demonstrate advanced fuels for UAV applications including advanced low temperature fuels and fuels to enable extended range and duration.			
(U)	In FY 2007: Demonstrate advanced low temperature and enhanced performance fuels for UAV applications focusing on technologies that expand the flight envelope, range, or duration of UAVs to include advanced thermal management concepts.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate efficacy of low-cost, environmentally friendly fuel additives to reduce soot particulate emissions from gas turbine engines using advanced research combustors and small turbine engines.	0.056	0.025	0.506
(U)	In FY 2005: Conducted pilot-light level demonstrations of additives that reduce soot emissions by at least 50 percent.			
(U)	In FY 2006: Continue pilot-light level demonstrations of additives that reduce soot emissions by at least 50 percent.			
(U)	In FY 2007: Demonstrate advanced additives to reduce soot and nitrogen oxides emissions in advanced propulsion concepts including combined cycle engines.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate enhancements to fuel system technology.	0.053	0.025	0.349
(U)	In FY 2005: Conducted pilot-light level design and development of hardware and fuel system simulators to evaluate key high temperature fuel system components of reusable aerospace vehicles focusing on aerospace vehicles with advanced and combined cycle engines that require high levels of fuel cooling.			
(U)	In FY 2006: Continue pilot-light level design and development of hardware and fuel system simulators to evaluate key high temperature fuel system components of reusable aerospace vehicles focusing on aerospace vehicles with advanced and combined cycle engines that require high levels of fuel cooling.			
(U)	In FY 2007: Continue design, development, and demonstration of hardware and fuel system simulators to evaluate key high temperature fuel system components of reusable aerospace vehicles focusing on aerospace vehicles with advanced and combined cycle engines that require high levels of cooling.			
(U)				
(U)	MAJOR THRUST: Identify, develop, and demonstrate low-cost approaches to reducing the fuel logistics footprint for the Expeditionary Air Force.	0.044	0.093	0.506
(U)	In FY 2005: Conducted pilot-light development of novel methods including bio- and nano-technology for fuel analysis.			
(U)	In FY 2006: Continue pilot-light development of novel methods including bio- and nano-technology for fuel analysis.			
(U)	In FY 2007: Demonstrate advanced nano-technology fuel additives, nano-technology fuel sensors, and novel			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 2480 Aerospace Fuels

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	detection and mitigation technologies for biological growth.			
(U)				
(U)	Total Cost	0.345	0.193	2.868

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602203F, Aerospace Propulsion.									
(U) PE 0602102F, Materials.									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603112F, Advanced Materials for Weapons Systems.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

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

PROJECT NUMBER AND TITLE: 3035 Aerospace Power Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3035 Aerospace Power Technology	4.701	8.702	5.652	6.135	4.613	4.707	4.796	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

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

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop power generation and conditioning, high rate batteries, and energy storage component and subsystem technologies for integration of high power subsystems with directed energy weapons (DEW). These technologies will enable the delivery of high power for operation of DEW. Note: In FY 2006, the megawatt superconducting power system demonstration activity will be moved to a separate effort in this Project.	1.491	0.976	0.917
(U) In FY 2005: Performed analysis of power system integration into an airframe as part of a non-lethal weapon system. Initiated preliminary design of and developed analytical model for a megawatt class power system demonstrator.			
(U) In FY 2006: Develop technology roadmaps and complete analysis of power system integration into an airframe as part of a non-lethal weapon system. Initiate design for a megawatt non-superconducting low duty cycle generator system tailored to directed energy weapons.			
(U) In FY 2007: Complete design and perform modeling and simulation of a megawatt non-superconducting low duty cycle generator system tailored to directed energy weapons.			
(U)			
(U) MAJOR THRUST: Develop power generation/conditioning/distribution component, energy storage, and thermal management components and subsystem technologies for manned and unmanned aircraft systems. These technologies will improve aircraft self-sufficiency, reliability, maintainability, and supportability, while reducing life cycle costs and enabling new capabilities. Note: In FY 2006, this activity will be completed.	1.575	1.249	0.000
(U) In FY 2005: Completed detailed design of demonstration electrical generator for integration into mid-thrust class engines.			
(U) In FY 2006: Complete engine integration and test of the internal starter generator in mid-thrust class engines.			
(U) In FY 2007: Not Applicable.			
(U)			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603216F Aerospace Propulsion and Power Technology**	PROJECT NUMBER AND TITLE **3035 Aerospace Power Technology**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST: Develop power generation/conditioning/distribution, energy storage, and thermal management components and subsystem technologies that are synergistic with aerospace and weapons platforms.	0.670	0.000	1.467
(U)	In FY 2005: Tested low volume/low weight high temperature motor drive.			
(U)	In FY 2006: Not Applicable. Note: The FY 2006 synergistic efforts will be delayed to FY 2007 to allow for multi-megawatt superconducting Applied Research activities to more fully develop.			
(U)	In FY 2007: Investigate alternative energy storage/generation systems for low power applications.			
(U)				
(U)	MAJOR THRUST: Develop analytical tools and subsystems for multi-megawatt superconducting electrical power systems including power generation, conditioning, and dynamic interaction. Note: Prior to FY 2006, the megawatt superconducting power system demonstration activity was included in the directed energy weapons effort in this Project.	0.000	1.745	3.268
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Complete preliminary design for a megawatt class power system demonstrator.			
(U)	In FY 2007: Initiate detailed design of megawatt class power system demonstrator and begin fabrication of key components.			
(U)				
(U)	CONGRESSIONAL ADD: Advanced Satellite Thermal Control Program.	0.965	1.676	0.000
(U)	In FY 2005: Expanded Electrochromics Coatings (EC) productions beyond the pilot scale level, developed processes incorporating EC into thin flexible films that can be bonded to satellite structures and tested EC devices in real application environments.			
(U)	In FY 2006: Develop EC's and prepare them for qualifying test on the Navy's Mid-Star micro-satellite, specifically addressing the electrode connection bonding with the EC.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Field Renewable Energy System Hybrids (FRESH) Li Ion Battery Program.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop rechargeable batteries for the 12V applications of the Battlefield Renewable Integrated Tactical Energy System program. The batteries are to have individually imbedded charge electronics so that they can recharge from any power source in the field. The batteries will be designed for use as wearable power sources and will interface with a hybrid power system.			
(U)	In FY 2007: Not Applicable.			
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 3035 Aerospace Power Technology

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) CONGRESSIONAL ADD: More Electric Technology for Mission Critical Power Systems.	0.000	2.070	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Select near-term and far term applications and then develop flightweight hardware, durability testing, and preliminary testing that would lead to eventual military qualification. The anticipated payoff of the technology is improved performance, reliability, and overall cost-effectiveness of mission-critical propulsion and power systems through replacement of fluid systems with magnetic and electrical components.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	4.701	8.702	5.652

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602201F, Aerospace Flight Dynamics.									
(U) PE 0602203F, Aerospace Propulsion.									
(U) PE 0602605F, Directed Energy Technology.									
(U) PE 0603605F, Advanced Weapons Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE: 4921 Aircraft Propulsion Subsystems Int	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4921	Aircraft Propulsion Subsystems Int	21.026	32.953	14.334	25.149	27.261	27.828	28.350	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

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

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates technology to increase turbine engine operational reliability, durability, mission flexibility, and performance, while reducing weight, fuel consumption, and cost of ownership. This project includes the Aerospace Propulsion Subsystems Integration (APSI) program, which includes demonstrator engines such as the Joint Technology Demonstrator Engine for manned systems and the Joint Expendable Turbine Engine Concept for unmanned air vehicle and cruise missile applications. The demonstrator engines integrate the core (high-pressure spool) technology developed under the Advanced Turbine Engine Gas Generator project with the engine (low-pressure spool) technology such as fans, turbines, engine controls, mechanical systems, exhaust nozzles, and augmentors. Additionally, these efforts include activities under the national High Cycle Fatigue (HCF) program. This project also focuses on system integration of inlets, nozzles, engine/airframe compatibility, and power and thermal management subsystems technologies. APSI provides aircraft with potential for longer range and higher cruise speeds with lower specific fuel consumption, surge power for successful engagements, high sortie rates with reduced maintenance, reduced life cycle cost, and improved survivability, resulting in increased mission effectiveness. Technologies developed are applicable to sustained high-speed vehicles and responsive space launch. APSI supports the goals of the national Integrated High Performance Turbine Engine Technology (IHPTET) program, which is focused on doubling turbine engine propulsion capabilities while reducing cost of ownership. Anticipated technology advances include turbine engine improvements providing an approximate 30 percent reduction in tactical fighter aircraft takeoff gross weight and 100 percent increase in aircraft range/loiter. APSI is also fully integrated into the Versatile Affordable Advanced Turbine Engine program (VAATE). The IHPTET and VAATE programs provide continuous technology transition for military turbine engine upgrades and derivatives, and have the added dual-use benefit of enhancing the United States turbine engine industry's international competitiveness.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Design, fabricate, and demonstrate durability and integration technologies for turbofan/turbojet engines. These technologies will improve durability, supportability, and affordability of current and future Air Force aircraft.	1.667	1.455	1.315
(U) In FY 2005: Validated the HCF Test Protocol by completing structural durability tests of advanced engine components and instrumentation.			
(U) In FY 2006: Design and develop agile combat support engine technologies to increase durability of components to include advanced aerodynamics for fans, turbines, mechanical systems, interactions between the inlet and fan, and controls/accessories.			
(U) In FY 2007: Fabricate and test agile combat support engine technologies to increase durability of components to include advanced aerodynamics for fans, turbines, mechanical systems, interactions between the inlet and fan, and controls/accessories.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 4921 Aircraft Propulsion Subsystems Int

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	MAJOR THRUST: Design, fabricate, and test advanced component technologies for improved performance and fuel consumption of turbofan/turbojet engines for fighters, bombers, sustained supersonic and hypersonic cruise vehicles, and transports. Each of these component technology innovations can be applied to a significant part of the Air Force's engine inventory and offer potentially significant performance enhancements to future aircraft engines enabling faster, more responsive systems with longer range and greater payload.	10.971	11.820	9.125
(U)	In FY 2005: Completed test of a HCF robust front frame, an affordable organic matrix composite fan frame and duct, a multi-stage forward swept fan, a damped low-pressure turbine (LPT) blade, a titanium matrix composite (TMC) shaft, and model-based flexible control with diagnostics. Completed advanced engine designs with an uncooled ceramic matrix composite (CMC) LPT blade and begin fabrication of multi-property rotor, fluidic control and modulated turbine cooling.			
(U)	In FY 2006: Complete fabrication and testing multi-property rotor, fluidic control, and modulated turbine cooling. Initiate advanced designs for lightweight engine (utilizes a hollow fan, radial compressor, and low profile combustor) capable of operating as primary propulsion or in a lift mode. Initiate advanced engine designs for a sustained supersonic engine using variable cycle features, an advanced fan, improved turbine using cooled metal and cooled CMCs, and lightweight CMC cases and ducts.			
(U)	In FY 2007: Enhance advanced designs for lightweight high bypass engine (utilizes a hollow fan, radial compressor, and low profile combustor) capable of operating as primary propulsion or in a lift mode. Enhance advanced engine designs for a sustained supersonic engine using variable cycle features, an advanced fan, improved turbine using cooled metal and cooled CMCs, and lightweight CMC cases and ducts.			
(U)				
(U)	MAJOR THRUST: Design, fabricate, and test advanced component technologies for limited life engines. These technologies improve the performance, durability, and affordability of engines for missile and unmanned air vehicles (UAVs), and subsonic to hypersonic weapon applications.	2.692	5.878	3.894
(U)	In FY 2005: Enhanced designs of advanced component technologies for intelligent and durability engine testing for UAVs. Completed initial designs of advanced component technologies for intelligent and durability engine testing to include an advanced fan/compressor, a ceramic turbine, turbine with new advanced cooling approach, and improved oil-less bearings.			
(U)	In FY 2006: Enhance design and begin fabrication of advanced high temperature cooled turbine blade and combustor for UAV applications. Enhance designs of advanced components for technologies for intelligent and durability engine testing to include an advanced fan/compressor, a ceramic turbine, turbine with new advanced cooling approach, and oil-less bearings.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 4921 Aircraft Propulsion Subsystems Int

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Continue fabrication of advanced high temperature cooled turbine blade and combustor for UAV applications. Begin fabrication of advanced components for technologies for intelligent and durability engine testing to include an advanced fan/compressor, a ceramic turbine, turbine with new advanced cooling approach, and oil-less bearings.			
(U)				
(U)	CONGRESSIONAL ADD: IHPTET Phase III Technology Demonstrator.	3.379	0.000	0.000
(U)	In FY 2005: Completed design, fabrication, instrumentation, and assembly of a multi-stage forward swept fan, an uncooled CMC low pressure turbine blade, and fluidic thrust vectoring in an advanced demonstrator engine.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: VAATE (Note: Only for the XTC 58F/1 demonstrator program) (this add was previously titled: Versatile Affordable Advanced Turbine Engine (Note: Only for the XTC 58F/1 for purposes demonstrating the integration of individual technologies for highly fuel efficient 10,000-15,000 pound thrust demonstrator engines needed for evolving UAVs)).	2.317	6.703	0.000
(U)	In FY 2005: Completed preliminary designs of advanced component technologies (includes an advanced fan and improved high temperature turbine blades) for intelligent and durability engine testing for UAVs.			
(U)	In FY 2006: Update the preliminary design and configuration of the common core by incorporating changes necessary to accommodate both UAV and heavy lift applications. Create detailed design of advanced component technologies for UAV applications.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: VAATE Advanced Supersonic Cruise Missile Engine.	0.000	5.914	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Perform risk reduction rig designs for the critical turbine, afterburner and nozzle components. Conduct testing of the rigs when fabrication is complete and initiate design process development for fabrication of a cast blisk turbine utilizing an advanced cooling concept.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Versatile Affordable Advanced Turbine Engine - 5K-7K Thrust Category.	0.000	1.183	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct system studies for the multipurpose core and associated design activities to extend its			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 4921 Aircraft Propulsion Subsystems Int

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	applicability to engines in the 5,000 to 7,000 pound turbofan thrust class.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	21.026	32.953	14.334

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities									
(U) PE 0602201F, Aerospace Flight Dynamics.									
(U) PE 0602203F, Aerospace Propulsion.									
(U) PE 0603003A, Aviation Advanced Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE: 4922 Space & Missile Rocket Propulsion	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4922	Space & Missile Rocket Propulsion	5.200	8.011	4.839	4.859	5.272	5.382	5.484	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates technologies for the sustainment of strategic systems (including solid boost/missile propulsion, Post Boost Control, and aging and surveillance efforts) and tactical rockets. Characteristics such as environmental acceptability, affordability, reliability, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion systems, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy propellants. Technological advances developed in this program are being accomplished in two phases and that could improve the performance of expendable systems' payload capabilities by approximately 15 percent (Phase I)/20 percent (Phase II) and reduce hardware and operation costs by approximately 25 percent (Phase I)/30 percent (Phase II). Aging and Surveillance efforts that could improve lifetime prediction capabilities by 10 years and reduce non-destructive test costs by 50 percent. The projects in this program are part of the Technologies for the Sustainment of Strategic Systems program and support the Integrated High Payoff Rocket Propulsion Technology program.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate missile propulsion and Post Boost Control Systems (PBCS) technologies for ballistic missiles.	2.159	2.251	0.981
(U) In FY 2005: Completed Phase I full-scale risk reduction component developments for the advanced PBCS demonstration. Completed demonstration of component technologies with readily available materials to reduce hardware costs with increased performance for the PBCS. Enhanced hardware development integrating case, nozzle, insulation, and propellant for the Missile Propulsion Demonstration Phase I. Completed Critical Design Review for nozzle, case, nozzle and igniter for the interim demos. Successfully cast one interim motor.			
(U) In FY 2006: Continue hardware development integrating case, nozzle, insulation, and propellant for the Missile Propulsion Demonstration Phase I.			
(U) In FY 2007: Complete the Missile Propulsion Demonstration Phase I.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate missile propulsion, PBCS, aging, and surveillance technologies for strategic systems. Efforts support the Technology for Sustainment of Strategic Systems - Phase II. Note: After FY 2006, the aging and surveillance efforts in this activity will become a separate activity in this project.	3.041	3.886	3.245
(U) In FY 2005: Conducted initial validation testing code for modeling and simulation tool (Phase II) development for analyzing and developing missile components,. Completed this development effort of aging and surveillance tools for predicting the health of solid rocket motors. Developed methods to apply these tools on a motor-by-motor basis			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 4922 Space & Missile Rocket Propulsion

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
vice a fleet wide basis.			
(U) In FY 2006: Continue modeling and simulation tools (Phase II) development for analyzing and developing missile components.			
(U) In FY 2007: Begin development of subcomponents to test the accuracy of the previously developed modeling and simulation tools and update the models with the resulting data for use in an upcoming Missile Propulsion demonstration.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate aging and surveillance technologies for strategic systems to improve lifetime prediction capabilities by 10 years and reduce non-destructive test costs by 50 percent. Efforts support the Technology for Sustainment of Strategic Systems Phase II. Note: Prior to FY 2006, the aging and surveillance efforts were part of another effort in this Project.	0.000	0.395	0.613
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Complete development of aging and surveillance tools for predicting the health of solid rocket motors and methods to apply these tools on a motor-by-motor basis vice a fleet wide basis.			
(U) In FY 2007: Initiate scale-up activities for an advanced service life prediction program integrating existing and advanced sensors, models, and tools to be able to predict the service life of a solid rocket motor on a motor-by-motor basis.			
(U)			
(U) CONGRESSIONAL ADD: Solid Boost Power Technology.	0.000	1.479	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Provide additional component testing and modeling, simulation, and analysis tool validation for solid rocket motor technologies supporting future ballistic missile upgrades.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	5.200	8.011	4.839

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602102F, Materials.									
(U) PE 0602203F, Aerospace Propulsion.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603216F Aerospace Propulsion and Power Technology**	PROJECT NUMBER AND TITLE **4922 Space & Missile Rocket Propulsion**

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

(U) PE 0602601F, Spacecraft Technology.

(U) PE 0603401F, Advanced Spacecraft Technology.

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.

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

(U) PE 0603114N, Power Projection Advanced Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 5098 Advanced Aerospace Propulsion	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5098	Advanced Aerospace Propulsion	23.004	22.882	34.167	22.832	23.838	24.331	24.789	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

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

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates via ground and flight tests the scramjet propulsion cycle to a technology readiness level appropriate for full integration with other engine cycles (including turbine and rocket-based) to provide the Air Force with transformational military capabilities. The primary focus is on the hydrocarbon-fueled, scramjet engine. Multi-cycle engines will provide the propulsion systems necessary to support aircraft and weapon platforms operating over the range of Mach 0 to 8+. Efforts include scramjet flow-path optimization to enable operation over the widest possible range of Mach numbers, active combustion control to assure continuous positive thrust (even during mode transition), robust flame-holding to maintain stability through flow distortions, and maximized volume-to-surface area to minimize the thermal load imposed by the high-speed engine. Thermal management plays a vital role in scramjet and combined cycle engines, including considerations for protecting low speed propulsion systems (e.g., turbine engines) during hypersonic flight.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate technologies for a hydrocarbon-fueled scramjet with robust operation over a range of Mach 4 to 8.	23.004	21.896	34.167

(U) In FY 2005: Fabricated flight weight scramjet engine with flight weight fuel control valves and closed loop control system. Performed initial preparation of Arnold Engineering Development Center (AEDC) and National Aeronautics and Space Administration (NASA) Langley tunnels for ground test of flight weight hydrocarbon-fueled, fixed geometry flow path. Completed component test of ramjet to scramjet mode transition in direct connect facility. Completed component level evaluation of engine ignition/start sequence and of engine control strategy. Conducted preliminary design of the Scramjet Engine Demonstrator (SED) vehicle and initiated detailed design of the scramjet engine demonstrator air vehicle. Conducted wind tunnel tests of the air vehicle models to determine aerodynamic forces and moments and vehicle stability and control. Conducted various design trade studies to ready the overall demonstrator design (includes air vehicle structures, avionics, instrumentations, scramjet propulsion systems, and boosters) for a critical design review.

(U) In FY 2006: Continue detailed design of the scramjet engine demonstrator air vehicle. Complete vehicle subsystem trade studies and designs for structures, avionics, instrumentation, booster and other necessary technologies. Conduct multiple risk reduction tests and analyses to reduce both aerodynamic and propulsion uncertainties prior to Critical Design Review. Conduct extensive transonic, supersonic, and hypersonic wind tunnel tests and simultaneously conduct computational fluid dynamics analyses of tested configurations. Conduct

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 5098 Advanced Aerospace Propulsion

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	aero-thermodynamic tests to ensure vehicle thermal protection system design meets requirements. Conduct additional propulsion related risk reduction tests to mature propulsion system subcomponents (hot gas valves, digital engine controller, fuel pump) and broaden the engine ground test matrix to better align with expected flight profiles.			
(U)	In FY 2007: Complete engine and vehicle designs and conduct vehicle critical design review. Fabricate and test flight clearance engine and initiate fabrication of flight engines. Establish flight test profiles and margins. Initiate fabrication of air vehicle flight hardware and begin flight test preparations at supporting test centers.			
(U)				
(U)	CONGRESSIONAL ADD: X-43C Development.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Design combined cycle engine propulsion system for potential low-cost flight demonstration under X-43C. Design options include legacy X-43C, X-51 derivative, and other research flight test configurations. Combined cycle engine propulsion system will combine scramjet engines with high-speed turbine and/or rocket engines. Turbine, rocket and scramjet engine components will include technology elements traceable to full-scale vision concepts. Performance of combined cycle engine propulsion system will be assessed analytically for performance, thrust margin, and propulsion mode transition during takeoff, transonic acceleration, supersonic, and hypersonic flight.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	23.004	22.882	34.167

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602102F, Materials									
(U) PE060203F, Aerospace Propulsion									
(U) This project will be coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE: 681B Advanced Turbine Engine Gas Generator	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
681B	Advanced Turbine Engine Gas Generator	21.834	24.422	25.828	25.927	28.139	28.721	29.259	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. The objective is to provide the continued evolution of technologies into an advanced gas generator in which the performance, cost, durability, reparability, and maintainability can be assessed in a realistic engine environment. The gas generator, or core, is the basic building block of the engine and nominally consists of a compressor, a combustor, a high-pressure turbine, mechanical systems, and core subsystems. Experimental core engine testing enhances rapid, low-risk transition of key engine technologies into engineering development, where they can be applied to derivative and/or new systems. These technologies are applicable to a wide range of military and commercial systems including aircraft, missiles, land combat vehicles, ships, and responsive space launch. Component technologies are demonstrated in a core (sub-engine) test. This project also assesses the impact of low spool components (such as inlet systems, fans, low pressure turbines, and exhaust systems) and system level technologies (such as integrated power generators and thermal management systems) on core engine performance and durability. The core performances of this project are validated on demonstrator engines in Project 4921 of this PE. Efforts are part of the Integrated High Performance Turbine Engine Technology (IHPTET) and the Versatile Affordable Advanced Turbine Engines (VAATE) programs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Design, fabricate, and performance test demonstration core engines, using innovative engine cycles and advanced materials to provide greater durability, improved performance, and reduced fuel consumption for turbofan/turbojet engines for fighters, attack aircraft, bombers, sustained supersonic and hypersonic cruise vehicles, and large transports. Each of these technology innovations can be applied to a significant part of the Air Force's engine inventory and offer potentially significant performance enhancements to future aircraft engines, thus enabling new capabilities for faster, survivable, durable, more responsive systems with longer range and greater payloads.	18.201	21.030	22.234

(U) In FY 2005: Completed design and fabrication of hardware for testing a cooled-cooling air system, micro-circuit cooled high pressure turbine blades, and blade outer air seals with advanced thermal barrier coating. Performed risk reduction tests of a magnetic bearing system for an advanced core engine. Initiated conceptual studies and preliminary designs of advanced core engine technologies, including systems level technologies residing within the core, applicable to advanced mobility, regional, and long range strike platforms.

(U) In FY 2006: Complete preliminary design and begin detailed design of advanced core engine technologies, including advanced turbine blade materials incorporating next generation cooling schemes, novel coatings to reduce combustor and turbine heat loads, ceramic turbine components, and systems for active control, thermal management, and power

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 681B Advanced Turbine Engine Gas Generator

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	extraction. Begin preliminary design and risk reduction planning for a tip turbine concept, including a novel compression system, innovative annular combustor, and advanced rotating seals. Begin design of unique compression system components.			
(U)	In FY 2007: Complete detailed design and begin fabrication of advanced core engine technologies, including advanced turbine blade materials incorporating next generation cooling schemes, novel coatings to reduce combustor and turbine heat loads, ceramic turbine components, and systems for active control, thermal management, and power extraction. Complete preliminary design and risk reduction planning for a tip turbine concept, including a novel compression system, innovative annular combustor, and advanced rotating seals. Continue design and begin fabrication of unique compression system components.			
(U)				
(U)	MAJOR THRUST: Design, fabricate, and durability test demonstration core engines to provide increased durability and affordability for turbofan/turbojet engines for fighters, attack aircraft, bombers, sustained supersonic and hypersonic cruise vehicles, and large transports. Note: Beginning in FY 2006, this effort will be transferred to the remaining thrusts in this project since durability efforts are integral to Air Force turbine efforts.	1.262	0.000	0.000
(U)	In FY 2005: Completed the design and fabrication of long lead hardware for evaluation in the national durability program.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Design, fabricate, and evaluate technology demonstration core engines to provide improved performance, greater durability, and lower fuel consumption for turboshaft/turbojet engines for trainers, rotorcraft and runway independent air vehicles, special operations aircraft, intratheater transports, subsonic powered munitions, and unmanned air vehicles (UAV).	2.371	3.392	3.594
(U)	In FY 2005: Completed core engine tests of a forward swept splittered compressor rotor, a high temperature rise combustor, a counter-rotating vaneless turbine, ceramic matrix composite turbine blades and vanes, and magnetic bearings. Initiated design of small versatile affordable core engine technologies, including eccentric high-pressure core components, monolithic ceramic rotor, and lubeless bearing system applicable to unmanned aerial vehicles (UAV) and powered munitions.			
(U)	In FY 2006: Further the design and begin selective risk reduction tests of UAV small versatile affordable advanced core engine technologies including a high heat release combustor, durable high performance turbine, nanolaminate coatings, and systems for thermal management and advanced power extraction. Begin planning for multi-Service demonstration of heavy fuel engine technologies for future rotorcraft.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 681B Advanced Turbine Engine Gas Generator

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Complete design, initiate hardware fabrication, and continue selective risk reduction tests of UAV small versatile affordable advanced core engine technologies including a high heat release combustor, durable high performance turbine, nanolaminate coatings, and systems for thermal management and advanced power extraction. Continue planning for multi-Service demonstration of heavy fuel engine technologies for future rotorcraft.			
(U)	Total Cost	21.834	24.422	25.828

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602201F, Aerospace Flight Dynamics.									
(U) PE 0602203F, Aerospace Propulsion.									
(U) PE 0603003A, Aviation Advanced Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

PE NUMBER: 0603231F
PE TITLE: Crew Systems and Personnel Protection Technology

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603231F Crew Systems and Personnel Protection Technology

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	29.375	34.968	32.156	32.685	35.835	36.488	36.822	Continuing	TBD
2830	Decision Effectiveness Technology	6.290	24.921	22.200	22.963	25.282	25.727	25.868	Continuing	TBD
3257	Helmet-Mounted Sensory Technologies	4.443	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
4923	Logistics Readiness and Sustainment	8.476	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
4924	Warfighter Readiness Technology	6.611	6.381	7.009	6.703	7.225	7.376	7.516	Continuing	TBD
5020	Bioeffects & Protection Technology	3.555	3.666	2.947	3.019	3.328	3.385	3.438	Continuing	TBD

Note: In FY 2006, Helmet-Mounted Sensory Technologies and Logistics Readiness and Sustainment efforts will move from Projects 3257 and 4923, respectively, to Project 2830. Funds for the FY 2006 Congressionally-directed Next Generation Helmet Tracking and Display Technology in the amount of $1.0 million and Air Operations Center Secured Data Access in the amount of $1.7 million are in the process of being moved to PE 0603231F, Crew Systems and Personnel Protection Technology, from PE 0603211F, Aerospace Technology Dev/Demo, and PE 0603789F, C3I Advanced Development, respectively, for execution.

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to enhance human performance and effectiveness and to enable the aerospace force. State-of-the-art advances are made to train personnel, protect and sustain warfighters, and improve human interfaces with weapon systems. The Decision Effectiveness Technology project develops and demonstrates warfighter capability enhancing technologies that promote effective decision-making, control, and mission execution in the emerging network-enabled operational environments. The Helmet-Mounted Sensory Technologies project develops and demonstrates advanced operator interface technologies for multifunctional helmet-mounted displays and night vision devices. The Logistics Readiness and Sustainment project develops and demonstrates technologies that will enhance logistics operations, and improve the design, deployability, performance, and support of current and future weapon systems. The Warfighter Readiness Technology project develops and demonstrates advanced training, simulation, and mission rehearsal technologies. The Bioeffects and Protection Technology project develops and demonstrates advanced technologies to provide laser eye protection, assure the safety of personnel involved with test, deployment, and operation of high-energy laser weapons, and enable detection/identification and neutralization of threat agents for counterproliferation. Note: In FY 2006, Congress added $1.0 million for Full Spectrum Laser Eye Protection, $1.7 million for Virtual Medical Trainer, $1.0 million for Variable Transmittance Visor, $0.5 million for Deployment Environment and Biological Surveillance, $1.5 million for Air Force Advanced Micro-Compression Sock (AFAMS). This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies to protect and enhance the performance of Air Force personnel in operational environments.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	33.595	29.775	31.726
(U)	Current PBR/President's Budget	29.375	34.968	32.156
(U)	Total Adjustments	-4.220	5.193	
(U)	Congressional Program Reductions		-0.002	
	Congressional Rescissions	-0.026	-0.505	
	Congressional Increases		5.700	
	Reprogrammings	-3.410		
	SBIR/STTR Transfer	-0.784		

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE: 2830 Decision Effectiveness Technology	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2830	Decision Effectiveness Technology	6.290	24.921	22.200	22.963	25.282	25.727	25.868	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, Helmet-Mounted Sensory Technologies and Logistics Readiness and Sustainment efforts will move from Projects 3257 and 4923, respectively, to Project 2830. Funds for the FY 2006 Congressionally-directed Next Generation Helmet Tracking and Display Technology in the amount of $1.0 million are in the process of being moved to PE 0603231F, Crew Systems and Personnel Protection Technology, from PE 0603211F, Aerospace Technology Dev/Demo, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates warfighter capability enhancing technologies and information operations technologies that promote effective decision-making, control, and mission execution in the emerging network-enabled operational environment. Included are advanced technologies that improve the ability of battlefield airmen to rapidly assimilate critical information and make timely and correct decisions, display technologies and decision aids that enhance time-critical strikes, and warfighter interface technologies that simplify and speed critical operations in air operation centers and battle management platforms. The project also develops technologies that enhance logistics functions, improve the fidelity and accuracy of large-scale military simulations, protect deployed personnel, improve human effectiveness during information operations and information warfare, and support counterproliferation. The ultimate goal is to assure warfighter decision effectiveness in Air Force operations.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate user-tailored information management and portrayal technologies that enhance battlespace situational awareness for global- and MAJCOM-level information warfare and air operations centers to reduce decision-making bottlenecks. Note: Effort completes in FY 2005.	1.230	0.000	0.000
(U) In FY 2005: Integrated a decision-making modeling, simulation, and analysis tool into final version of previously demonstrated combat assessment tool and transitioned into joint and/or Air Force weapon systems. Developed collaborative information sharing for operation centers' information management tool. Completed and integrated final version information management tool into joint and/or Air Force weapon systems.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate human-centered tools for the Air Force Information Operations (IO) and Intelligence, Surveillance and Reconnaissance (ISR) communities. Provide the IO/ISR warrior with tailored decision support systems, guidelines for effective selection of IO/ISR warriors, IO/ISR simulators and training systems, enhanced decision-making tools, and automated tools to reduce operator task load and improve data exploitation.	1.699	2.984	2.895
(U) In FY 2005: Developed and demonstrated tools, methods, and technology to gain, exploit, defend, and attack			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE 2830 Decision Effectiveness Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	information. Identified and prioritized IO capabilities for enhancement by exemplar technologies and methods. Developed, demonstrated, and evaluated IO support tools and technologies to assess operational impact.			
(U)	In FY 2006: Continue to develop and demonstrate tools, methods, and technology to gain, exploit, defend, and attack information. Develop IO capabilities for enhancement by exemplar technologies and methods. Begin research to develop tools and techniques to improve operator performance for ISR planning and analysis.			
(U)	In FY 2007: Continue development of maturing IO/ISR tools, methods, and technology to gain, exploit, defend, and attack information. Continue maturation and development of IO capabilities enhancement technology. Develop and demonstrate tools and techniques to improve operator performance for ISR planning and analysis. Begin to develop ISR optimal displays and enhanced exploitation for ISR operators. Begin to develop advanced training methodologies and tools for ISR operators.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate human effectiveness technologies to improve combat effectiveness reporting, situation assessment updates, and decision support for Combined Air and Space Operations Centers (CAOC).	1.096	2.569	2.805
(U)	In FY 2005: Developed user-tailorable visualization tools to optimize human perception of battlespace situational awareness. Demonstrated enhanced collaborative capability for effective, time-critical information exchange operations between CAOC and other operational units.			
(U)	In FY 2006: Develop initial decision-centric visualization tools focused on the areas of strategy planning, assessment of operational effectiveness, and battle predictions. Integrate these visualization tools with other tools relevant to strategy planning and operational assessment.			
(U)	In FY 2007: Commence field tests of the visualization tools in an operational environment or exercise. Develop additional tools to allow more advanced collaboration within the strategy division and with other groups in the air operations center.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate technologies to interface between ground controllers and multiple machine components through unified visual and auditory displays. Technologies address ground controller-specific requirements leading to faster mission execution timelines, reduced targeting and fratricide errors, and increased situational awareness through positional awareness of friend and foe in the combat zone.	1.200	2.759	2.900
(U)	In FY 2005: Demonstrated operator-augmented vision interfaces for ground controller-specific Unmanned Aerial Vehicle (UAV) platforms. Developed intelligent UAV search patterns for improved target location. Demonstrated user independent speech recognition in high-noise environments.			
(U)	In FY 2006: Continue to develop intelligent UAV search patterns for improved target location. Begin to develop			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE 2830 Decision Effectiveness Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	UAV display tools that speed the delivery of UAV imagery integrated with cultural and targeting information to special operations forces. Continue to develop user independent speech recognition and language translation customized for ground controller equipment and Terminal Attack Control (TAC) earplug microphones.			
(U)	In FY 2007: Complete development and demonstration of advanced interface technologies between ground controllers and multiple machine components through unified visual and auditory displays. Demonstrate UAV interfaces featuring intelligent agent search patterns in the ground controller operational environment. Demonstrate operator headgear incorporating basic operator status reporting and wearable displays. Demonstrate user independent speech recognition and language translation customized for ground controller equipment and TAC earplug microphones.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate decision-aiding technologies that assist the Joint Forces Commander (JFC)/Joint Forces Air Component Commander (JFACC) to rapidly assess the battlefield situation, predict the most likely adversary behaviors, and select and prioritize the appropriate courses of action. Note: In FY 2006, this increase in funding is due to greater emphasis in commander's predictive environment (CPE).	0.000	0.500	1.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop a scenario-based cognitive work analysis based on global strike and global persistent attack missions as a command and control knowledge base for the CPE. Begin developing an initial CPE decision aid and visually interactive simulation.			
(U)	In FY 2007: Begin first spiral development cycle of a decision aid that will support global military operations by providing a common global picture, fully integrating military planning, operations, and supporting intelligence, and enabling real-time reachback to operational and intelligence knowledge sources.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate advanced visual display technologies to provide integrated day/night capability to reduce pilot workload and enhance mission performance. Note: In FY 2006, this effort moved from Project 3257.	0.000	2.150	2.412
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop lightweight, ruggedized displays that operate in demanding special operations environments. Perform a laboratory evaluation to determine the optimal configuration to present information to special operations personnel. Investigate the utility of incorporating day and night sensors into a single helmet-mounted display.			
(U)	In FY 2007: Demonstrate in an operational environment that lightweight, ruggedized displays can be successfully integrated into Air Force special operations equipment. Begin to develop an integrated helmet display prototype that			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE 2830 Decision Effectiveness Technology

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
includes day and night sensors and provides the operational capabilities identified by the completed utility investigation.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate counterproliferation technologies to enhance force protection and enable air operations commanders to maintain operations tempo. Note: In FY 2006, this increase in funding is due to greater emphasis in counterproliferation technologies.	0.000	0.478	1.188
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Define parameters of biological warfare agent identification. Design new agent identification technologies and appropriate testing methods and conditions to perform operational field evaluations.			
(U) In FY 2007: Evaluate the capabilities of emerging technologies to locate biological warfare agents. Begin development of DNA-based identification technologies that will lead to affordable and reliable techniques to locate, identify, and track enemy held biological warfare agents.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate intelligent software agents, realistic human and organizational behavior models, and advanced job performance aiding technologies. Computer agents and models add realism and fidelity to large-scale synthetic environments and war games, and provide intelligence analysts a way to model collected data. Job aiding technologies provide command and control operators with automated access to a manageable amount of multi-source critical information to avoid operator overload and to support fast and accurate decision-making during mobility operations. Note: In FY 2006, this effort moved from Project 4923.	0.000	4.050	3.999
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Evaluate methods to improve validating human performance models. Begin to develop a human performance model that can represent behavioral variations due to cultural differences. Begin to transition to an Air Mobility Command program office a set of work-centered collaborative planning and decision-making software tools. Begin to develop composable human computer interface elements that can be assembled via computer network into a rapidly reconfigurable command and control system.			
(U) In FY 2007: Demonstrate in the laboratory a human performance model that can represent behavioral variations due to cultural differences. Begin a series of critical experiments toward modeling a society as a complex systems of systems. Complete the transition of work-centered collaborative planning and decision-making software to the Air Mobility Command. Continue to develop composable command and control (C2) human computer interface elements that can be assembled via computer network into a rapidly reconfigurable C2 system. Conduct initial laboratory experiments on composable C2 modules.			
(U)			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603231F Crew Systems and Personnel Protection Technology**	PROJECT NUMBER AND TITLE **2830 Decision Effectiveness Technology**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST: Develop and demonstrate logistics technologies for improved deployment operations and improved system supportability. These technologies will improve the efficiency and effectiveness of Air Force deployments and mobility operations in support of Agile Combat Support initiatives and Air Expeditionary Force concepts. Note: In FY 2006, this effort moved from Project 4923.	0.000	4.226	2.048
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Continue to develop and apply technology to automatically collect and update critical information required to effectively manage logistics resources in support of combat operations. Continue to design and develop very fast, easy-to-use dynamic planning/replanning capabilities for adaptive logistics. Continue work define coalition command and control information requirements to support cross-cultural planning and coordination.			
(U)	In FY 2007: Complete development and application of technology to automatically collect and update critical information required to effectively manage logistics resources in support of combat operations. Complete design and development of very fast, easy-to-use dynamic planning/replanning capabilities for adaptive logistics. Continue work to define coalition command and control information requirements to support cross-cultural planning and coordination. Begin work on defining requirements for emergency response logistics needs.			
(U)				
(U)	MAJOR THRUST: Develop collaborative interfaces for advanced C2 aircraft that will improve human/machine shared operational understanding of the battlespace. Develop human-centered specifications for a prototype workstation and optimize the physical layout of the workstations. Note: In FY 2006, this increase in funding is due to greater emphasis in collaborative interfaces.	0.000	0.214	2.273
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Define the concept of a collaborative toolkit for battle management C2. Establish and document requirements for an advanced C2 workstation that integrates the battle management visualization and collaborative tools.			
(U)	In FY 2007: Begin to develop the temporal and spatial interface and the logic for automated target prioritization. Begin to develop a collaborative toolkit that provides a shared understanding of the C2 battlespace. Refine the criteria and begin to develop an air battle management workstation that eliminates physical obstructions to team communication, supports team reconfiguration, supports in-place crew rest, and integrates the tools developed both to help warfighters assimilate information and to execute the sensor-shooter cycle more efficiently and effectively.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate human protective system technologies for extended missions. Technologies will improve aircrew comfort, resulting in increased performance. Note: In FY 2006, this increase in	0.000	0.357	0.680

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE 2830 Decision Effectiveness Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	funding is due to greater emphasis in human protective system technologies.			
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop aircrew safety technologies to support long duration missions. Initiate development of optimized seat system technologies to improve safety, comfort and performance.			
(U)	In FY 2007: Continue research on optimizing seat system technologies to improve safety, comfort, and performance. Develop and evaluate candidate seat system optimization technologies that reduce aircrew fatigue and discomfort, while maintaining spinal alignment. Extend design concepts to ensure accommodation of the full aircrew population.			
(U)				
(U)	CONGRESSIONAL ADD: Virtual Warriors.	1.065	0.000	0.000
(U)	In FY 2005: Integrated a virtual model of 3-D human and workspace into distributed simulation of an air operations center's time-critical targeting (TCT) team, demonstrated the model's interactions with human TCT operators, and demonstrated the technical potential to revolutionize team design and team training.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Air Force Advanced Micro-Compression Sock (AFAMS).	0.000	1.479	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for AFAMS.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Deployment Environment and Biological Surveillance.	0.000	0.493	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Deployment Environment and Biological Surveillance.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Variable Transmittance Visor.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Variable Transmittance Visor.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Virtual Medical Trainer.	0.000	1.676	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE 2830 Decision Effectiveness Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Conduct Congressionally-directed effort for Virtual Medical Trainer.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	6.290	24.921	22.200

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602202F, Human Effectiveness Applied Research.									
(U) PE 0604706F, Life Support Systems.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	0603231F Crew Systems and Personnel Protection Technology	3257 Helmet-Mounted Sensory Technologies

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3257	Helmet-Mounted Sensory Technologies	4.443	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, Helmet-Mounted Sensory Technologies efforts will move from Project 3257 to Project 2830.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced technologies for ejection-safe, multifunctional helmet-mounted displays and night vision devices. Development of helmet-mounted tracker and display (HMT/D) technologies will enable pilots to detect, identify, target, and launch weapons faster and more accurately. Development of improved aircrew night vision goggle technologies will enhance aerial combat capabilities at night.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate advanced HMT/D and subsystem technologies to improve mission effectiveness and pilot situational awareness during day and night missions in all-weather conditions. These technologies help pilots to detect, identify, target, and engage with weapons faster and more accurately.	1.778	0.000	0.000
(U) In FY 2005: Assessed capability of integrated symbology sets and advanced head tracker to reduce target acquisition and engagement timelines at night. Demonstrated real-time target information on HMT/D to destroy time-critical ground targets. Demonstrated space-stabilized head-up displays on HMT/D in laboratory.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate advanced visual display technologies to provide integrated day/night capability for optimizing display of information, reducing pilot workload, and enhancing mission performance.	2.665	0.000	0.000
(U) In FY 2005: Investigated the utility of miniature digital night vision devices and head-mounted displays for providing imagery and video, both to aircrew and to Air Force combat controllers, including night vision goggles and computer displays. Assessed leading edge display technologies to support fielding of laser eye protection and laser hardening technologies with advanced HMT/Ds and night vision goggles.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	4.443	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE 3257 Helmet-Mounted Sensory Technologies

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602202F, Human Effectiveness Applied Research.

(U) PE 0602102F, Materials.

(U) PE 0603112F, Advanced Materials for Weapon Systems.

(U) PE 0603319F, Airborne Laser Program.

(U) PE 0604706F, Life Support Systems.

(U) PE 0604201F, Integrated Avionics Planning and Development.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **03 Advanced Technology Development (ATD)**

PE NUMBER AND TITLE: **0603231F Crew Systems and Personnel Protection Technology**

PROJECT NUMBER AND TITLE: **4923 Logistics Readiness and Sustainment**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4923 Logistics Readiness and Sustainment	8.476	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006, Logistics Readiness and Sustainment efforts will move from Project 4923 to Project 2830.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates technologies that will enhance logistics support functions; improve the effectiveness of logistics information systems and command and control systems; enhance the fidelity and accuracy of large-scale military simulations; and improve the protection of personnel in deployed environments. This includes technologies to model and simulate intelligent behavior; to better integrate the human with computer-based information systems; to provide near real-time status of logistics resources and aircraft status; and to perform earlier prediction of the effects of exposure to hazardous chemicals. The resulting efforts will improve warfighter decision-making in the areas of logistics management, C2, and force protection.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate intelligent software agents and realistic human and organizational behavior models. These computer agents and models will add realism and fidelity to large-scale synthetic environments and war games, provide intelligence analysts a way to model collected data, and improve the user interaction with logistics information systems.	1.194	0.000	0.000
(U) In FY 2005: Developed human behavior based computer models that enable the study of information operations on C2 echelons and that better represent logistics functions in synthetic exercises.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate logistics technologies for improved deployment operations and improved system supportability. These technologies will maximize the efficiency and effectiveness of Air Force deployments and mobility operations in support of Agile Combat Support initiatives and Air Expeditionary Force concepts.	2.475	0.000	0.000
(U) In FY 2005: Developed and applied technology to automatically collect and update critical information required to effectively manage logistics resources in support of combat operations. Designed and developed very fast, easy-to-use dynamic planning/replanning capabilities for adaptive logistics. Defined coalition and control information requirements to support cross-cultural planning and coordination.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE 4923 Logistics Readiness and Sustainment

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST: Develop and demonstrate advanced job performance aiding technologies to enhance the utility of global air mobility C2 systems. These technologies will provide C2 operators with automated access to a manageable amount of critical information from multiple sources to avoid operator overload and thus support faster, more accurate decision-making and problem resolution during mobility operations.	2.613	0.000	0.000
(U)	In FY 2005: Developed artificial intelligence software that can automatically draw conclusions, developed work-centered collaborative planning tools, and developed advanced decision support technologies. Demonstrated these technologies in an operational environment within the Tanker Airlift Control Center.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate technologies that will enhance and streamline aircraft maintenance processes to improve the Air Force's ability to meet Air Expeditionary Force requirements by providing faster and more accurate methods of diagnosing and predicting component failures.	2.194	0.000	0.000
(U)	In FY 2005: Developed cognitive decision technologies, new information fusion techniques, and algorithms to determine failure trends for improved maintenance troubleshooting. Developed revolutionary formats for presenting technical information and software tools that support collaborative problem solving during aircraft maintenance.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	8.476	0.000	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602201F, Aerospace Flight Dynamics.									
(U) PE 0602202F, Human Effectiveness Applied Research.									
(U) PE 0603721N, Environmental Protection.									
(U) PE 0604708F, Civil, Fire, Environmental, Shelter.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603231F Crew Systems and Personnel Protection Technology**	PROJECT NUMBER AND TITLE **4923 Logistics Readiness and Sustainment**

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

(U) PE 0604740F, Integrated Command and Control Applications.

(U) PE 0605801A, Programwide Activities.

(U) PE 0708011F, Industrial Preparedness.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE: 4924 Warfighter Readiness Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4924 Warfighter Readiness Technology	6.611	6.381	7.009	6.703	7.225	7.376	7.516	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the FY 2006 Congressionally-directed Air Operations Center Secured Data Access in the amount of $1.7 million are in the process of being moved to PE 0603231F, Crew Systems and Personnel Protection Technology, from PE 0603789F, C3I Advanced Development, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced training, simulation, and mission rehearsal technologies that will improve warfighter capabilities and mission readiness by enhancing operator and team performance skills. This effort includes the development of technologies that enable integration of computer models, live weapon systems, and weapon system simulators to portray the global battlespace, including all-weather, day/night flight operations, C2, force protection, and aerospace operations. This project develops and demonstrates advanced training and simulation technologies that will improve warfighter readiness by enhancing mission training and mission rehearsal capabilities. Development and effective use of the global battlespace requires advances in training systems and in interconnection, information, visual, and representation technologies. The resulting mission training and rehearsal capabilities will enhance the mission essential competencies of combat and combat support individuals and teams that comprise the aerospace force.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Advance aerospace and organizational behavior models for integrated warfighter training and rehearsal. These computer agents and models will add realism operations, C2, force protection, and air base defense warfighters. Technologies will increase training effectiveness and efficiency, and decrease time to mission qualification.	0.923	2.219	2.984

(U) In FY 2005: Developed and validated capability to conduct integrated C2 and combat employment training and rehearsal. Developed specifications for a deployable Distributed Mission Operations (DMO) training and rehearsal technology suite for full combat tactical weapons employment mission planning, training, and rehearsal. Completed collaborative toolset for mission analysis and tracking. Demonstrated an integrated live-fly and virtual simulation performance measurement capability and evaluate its operational utility. Completed first DMO skills development, assessment, and decay study for combat air forces.

(U) In FY 2006: Demonstrate the Performance Evaluation and Tracking System. Integrate the current Battlefield Air Operations toolkit training devices into an immersive, DMO compatible training system, capable of mission training and rehearsal. Develop a preliminary mission planning toolset for a deployable, modest fidelity environment that permits training designers to develop tactical scenarios and to employ constructive forces, live players, or other virtual players.

(U) In FY 2007: Develop specifications of interfaces between DMO Mission Training Centers and Live Training Ranges. Develop a proof of concept Joint Close Air Support schoolhouse simulation environment. Develop

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE 4924 Warfighter Readiness Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	preliminary exercise planning and analysis shells to enable a robust scenario authoring capability that reduces training development time. Develop performance measurement and monitoring tools for a deployable training environment. Perform a small-footprint training demonstration in a persistent wargaming environment. Initiate development of specifications for managing learning in distributed training contexts.			
(U)				
(U)	MAJOR THRUST: Demonstrate advances in simulator visual system technologies through the development of ultrahigh resolution projection systems and associated low-cost high-fidelity image generator, and thin-film holographic collimating display technologies. Technologies will create high-definition immersive virtual environment for aircrew readiness training and mission rehearsal, allowing improved air-to-air/ground mission rehearsal capability for the warfighter. Note: This effort completes in FY 2005.	3.030	0.000	0.000
(U)	In FY 2005: Designed and fabricated the frame and display structure and visual system controller for the next generation, full field-of-view 20/20 visual display system. Integrated proof-of-concept ultrahigh-resolution laser projectors with open-standard external interfaces, capable of displaying over ten times the resolution currently displayed by commercial High-Definition Television projectors. Designed and developed high-performance, low-cost image generator based on commodity graphics along with a high-resolution terrain database to provide visual and sensor imagery at 60 Hz. Integrated advanced visual technologies to create the 20/20 Immersive Visual Display.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop a low-cost, helmet-mounted, deployable simulation system with sufficient image resolution and performance capable of supporting the imaging of high-resolution fast-moving targets, high-density terrain, texture, and surround imagery, and helmet-mounted sights. This technology will provide the warfigher realistic air-to-air and air-to-ground visual simulation environments to support aircrew training during expeditionary deployments and at Mission Training Centers. Note: In FY 2006, this increase is due to greater emphasis in visual simulation environments.	0.000	0.876	1.074
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Design and develop off-boresight targeting simulation for DMO multifaceted simulator displays. Define display design requirements for head-mounted and deployable training devices, define next generation design configurations, and evaluate alternative display concepts.			
(U)	In FY 2007: Begin development of head-mounted and deployable display proof-of-concept training devices. Conduct engineering and human factors analyses of the proof-of-concept display training devices.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE 4924 Warfighter Readiness Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	MAJOR THRUST: Develop and demonstrate training technologies and techniques to optimize night vision device-aided night operations. These technologies could reduce the cost of Night Vision Goggle (NVG) qualification and increase combat capability.	1.293	1.706	0.697
(U)	In FY 2005: Developed the functional specification for a desktop NVG visualization trainer suitable for initial NVG familiarization training, mission planning/preview, and mishap investigation. Developed eye position monitor for use with simulated NVG to determine spatial orientation awareness. Developed and evaluated simulator based spatial orientation scenarios for NVG use. Determined the training value of high-fidelity NVG visual simulation on mission qualification time.			
(U)	In FY 2006: Develop desk-top NVG visualization trainer for mission preview and mishap investigation applications. Develop NVG mission brief/debrief technologies. Develop NVG spatial orientation training protocols. Develop and evaluate performance metrics for NVG instrument scan, cross-check, and spatial orientation. Develop formats for reusable and interoperable material properties-coded datasets suitable for NVG and other sensor simulation. Develop and evaluate physics-based simulation approach in a variety of visual displays. Develop virtual terrain board instructional module for introductory NVG academic training.			
(U)	In FY 2007: Develop NVG simulator scenarios and related performance metrics for advanced NVG employment training. Develop geo-specific databases and database modification tools for desk-top NVG visualization training. Test simulated panoramic NVG in DMO test bed. Develop untethered NVG simulation for NVG video and head position by application of broadband wireless technology. Demonstrate head position driven simulated NVG imagery viewable by multiple viewers in an open space.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate a high-fidelity DMO training and rehearsal capability for operators in an air and space operations center (AOC). Link AOC operational mission requirements and performance metrics to develop team learning environments for AOC units.	1.365	1.580	2.254
(U)	In FY 2005: Developed preliminary competency-based requirements for use at the operational units and evaluated alternative content development and delivery methods. Developed tools and authoring shells for courseware development. Explored alternative local and DMO training and rehearsal technologies in operational exercises and experiments.			
(U)	In FY 2006: Develop performance indicators to enable performance measurement capability for team- and individual-level AOC operators. Develop initial functional specifications for computer-assisted training scenario for AOC operators. Evaluate and enhance training syllabi and methods for team- and individual-level AOC operators. Develop AOC training and rehearsal capabilities within the larger DMO training and rehearsal environment.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE 4924 Warfighter Readiness Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Develop a proof-of-concept multi-team competency-based training package with performance assessment system capability for the AOC. Develop initial competency-based scenario selection guidelines and conduct a proof-of-concept test of competency-based scenario training capability for operational planners.			
(U)	Total Cost	6.611	6.381	7.009

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602202F, Human Effectiveness Applied Research.

(U) PE 0604227F, Distributed Mission Training.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE: 5020 Bioeffects & Protection Technology	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5020 Bioeffects & Protection Technology	3.555	3.666	2.947	3.019	3.328	3.385	3.438	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project integrates and demonstrates technologies to provide protection against directed energy threats and hazards, without compromising performance, vigilance, or mission effectiveness, and counterproliferation technologies for the detection and neutralization of threat agents. Development and demonstration efforts focus on advanced technologies for laser eye protection (LEP), preventing injurious exposures of personnel involved with test and evaluation of high power microwave or high-energy laser weapons, and enabling operational employment of these systems. It also develops tools and guidelines for testing and deploying high power microwave and high-energy laser systems and technologies to enhance personnel safety and effectiveness in aerospace operations. Fatigue prediction and management capabilities are developed and demonstrated to enable risk management of the effects of sleep loss, circadian disruption, and shiftwork on cognitive readiness in surge, night, global, information warfare, C2, and other operations.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate multiwavelength LEP technologies for aircrew and ground personnel to provide protection against any laser hazard or threat in a single device.	1.786	0.808	0.859
(U) In FY 2005: Initiated development of direct-view LEP technologies for improved detection of targets. Continued development of next generation LEP goggles for Air Force Special Operations Command (AFSOC) air and ground forces for use in night operations with visible laser designators and illuminators. Completed development of LEP mini-band lenses for use with the Improved Aircrew Spectacle. Completed support for development and evaluation of a Laser Detector and Warning system for integration into aircraft cockpits and agile LEP. Completed demonstration and aircrew evaluations of peripheral LEP protection for wear with laser-hardened NVGs.			
(U) In FY 2006: Begin developing an integrated LEP and hypervision (visual acuity better than 20/20) demonstration system to provide full-spectrum laser protection while restoring vision degraded by the LEP to better than normal. Begin development of wrap-around LEP spectacle technology with prescription capabilities.			
(U) In FY 2007: Continue development of integrated eye protection technologies. Demonstrate and deliver second-generation LEP goggles for AFSOC air and ground forces.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate technologies that permit safe testing, deployment, and use of high energy laser weapons and systems.	1.319	0.393	0.568
(U) In FY 2005: Developed real-time laser range safety tool permitting commanders and range personnel immediate response on laser safety predictions arising from use of airborne lasers. Demonstrated Probabilistic Risk Assessment as an approach to high energy laser range safety. Presented initial recommendations for revisions to national			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603231F Crew Systems and Personnel Protection Technology**	PROJECT NUMBER AND TITLE **5020 Bioeffects & Protection Technology**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	consensus standards for near infrared wavelengths.			
(U)	In FY 2006: Integrate existing models of airborne laser wavelength-specific dose-response curves to the initial Probabilistic Risk Assessment software library.			
(U)	In FY 2007: Combine modeling and experimental measurement of additional multiple-wavelength exposures to airborne laser wavelength and other near-infrared laser beams to define the relative damage thresholds of the combined exposures when compared to their single-wavelength counterparts.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate technologies to support testing of counterforce technologies of threat agents during military operations.	0.450	0.492	0.869
(U)	In FY 2005: Defined performance parameters and developed technologies for threat neutralization, focusing on special operations needs. Conducted testing of breadboard man-portable neutralization technologies for counterproliferation.			
(U)	In FY 2006: Enhance neutralization technologies to optimize performance for specific operational conditions. Conduct laboratory tests to assess performance under simulated operational conditions.			
(U)	In FY 2007: Continue enhancement/assessment of agent neutralization devices and integrate with threat detection technologies. Demonstrate most promising man-portable threat neutralization technologies in simulated environments. Begin development of technologies to identify sources of biological warfare agents and ability to track, capture or destroy agents.			
(U)				
(U)	MAJOR THRUST: Develop a fatigue management capability to alleviate the negative effects of fatigue on human performance in aerospace operations. Results will extend and enhance human performance and survivability in sustained and continuous (24/7) mission environments for all aviation, C2, special operations, maintenance, and space operators. Note: In FY 2006, this increase is due to greater emphasis in biologically-based performance enhancement technologies.	0.000	0.987	0.651
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Integrate modeling of specific fatigue effects and interventions into model-based fatigue management capability. Improve and demonstrate operational usability of fatigue management capability. Expand fatigue model capability to predict operational task performance and address shiftwork applications.			
(U)	In FY 2007: Integrate biobehavorial performance model for selected military tasks into force simulations and wargaming exercises, thereby eliminating erroneous simulation outcomes based on current human performance models. Demonstrate operational strategies and associated delivery mechanisms to improve human performance in specific operational military environments.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER AND TITLE 5020 Bioeffects & Protection Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
(U)			
(U) CONGRESSIONAL ADD: Full Spectrum Laser Eye Protection.	0.000	0.986	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Initiate Congressionally-directed effort for Full Spectrum Laser Eye Protection.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	3.555	3.666	2.947

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602102F, Materials.									
(U) PE 0602202F, Human Effectiveness Applied Research.									
(U) PE 0603112F, Advanced Materials for Weapon Systems.									
(U) PE 0603319F, Airborne Laser Program.									
(U) PE 0604706F, Life Support Systems.									

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0603270F
PE TITLE: Electronic Combat Technology

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603270F Electronic Combat Technology

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	37.883	33.342	24.436	24.857	26.978	27.578	28.094	Continuing	TBD
2432	Defensive System Fusion Technology	7.386	7.432	5.183	5.270	5.720	5.839	5.950	Continuing	TBD
431G	RF Warning & Countermeasures Tech	14.567	9.888	8.387	8.531	9.259	9.495	9.674	Continuing	TBD
691X	EO/IR Warning & Countermeasures Tech	15.930	16.022	10.866	11.056	11.999	12.244	12.470	Continuing	TBD

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to support Air Force electronic combat (EC) warfighting capabilities. The program focuses on developing components, subsystems, and technologies with potential aerospace combat, special operations, and airlift EC applications in three project areas. The first project develops and demonstrates technologies for integrating EC sensors and systems into a fused and seamless whole. The second project develops and demonstrates advanced technologies for radio frequency EC suites. The third project develops and demonstrates advanced warning and countermeasure technologies to defeat electro-optical, infrared, and laser threats to aerospace platforms. Note: In FY 2006, Congress added $1.0 million for RAPCEval, $1.4 million for Detect and Avoid for UAVs, $2.1 million for Affordable Visible Missile Warning System, $1.0 for Electronic Combat Battle Management, $1.4 million for BLADES, $2.0 million for Advanced Threat Alert ATD - Technology Insertion, and $1.0 million for the Infrared Countermeasures Electronics Improvement Program. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and EC system developments that have military utility and address warfighter needs.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	39.234	23.923	24.159
(U)	Current PBR/President's Budget	37.883	33.342	24.436
(U)	Total Adjustments	-1.351	9.419	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.030	-0.481	
	Congressional Increases		9.900	
	Reprogrammings	-0.495		
	SBIR/STTR Transfer	-0.826		
(U)	Significant Program Changes:			

Not Applicable.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603270F Electronic Combat Technology

PROJECT NUMBER AND TITLE: 2432 Defensive System Fusion Technology

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2432	Defensive System Fusion Technology	7.386	7.432	5.183	5.270	5.720	5.839	5.950	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates technologies for integrating electronic combat (EC) sensors and EC system fusion. It develops advanced algorithms and assessment techniques needed to evaluate and enable combat aircraft operations in multi-spectral threat and countermeasure environments. It also matures technologies required for command and control warfare (C2W), stand off jamming, and electronic support measures for the denial, disruption, and suppression of adversary air defense operations. Technologies included are: advanced components and techniques needed to jam enemy radars; advanced stand off jammer technologies; and electronic collection methods to inform field commanders of changes in the electronic environment.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and investigate offensive counter information warfare technologies to disrupt and deny hostile command and control nodes and networks. Note: This effort completes in FY06.	2.870	0.853	0.000
(U) In FY 2005: Integrated flyable hardware and software for the Electronic Attack/Electronic Support (EA/ES) support system to counter high-speed, wideband data and communication links utilized by multiple ground-based and airborne platforms.			
(U) In FY 2006: Complete the EA/ES support system integration. Conduct laboratory and field tests of the countermeasure system to verify the capability to counter high-speed, wideband data communication links utilized by multiple ground-based and airborne platforms. Develop an integrated, networked approach to disrupt and deny current and future Integrated Air Defense Systems.			
(U) In FY 2007: Not applicable.			
(U)			
(U) MAJOR THRUST: Develop and integrate advanced sensor receiver and processing technologies.	1.972	0.576	0.596
(U) In FY 2005: Conducted evaluations and risk reduction demonstrations of defensive sensors and fusion of multiple information sources for situational awareness in the Integrated Demonstrations and Applications Laboratory (IDAL). Conducted IDAL laboratory risk reduction evaluations and demonstrations that evolve and optimize sensor fusion algorithms for utilization on tactical platforms that provide real-time threat situational awareness. Conducted IDAL laboratory risk reduction evaluations and demonstrations for advanced digital receiver and processor technologies that provide the warfighter with multispectral warning, identification, and threat response for current and next generation aerospace platforms.			
(U) In FY 2006: Perform risk reduction for defensive sensors using multiple information sources for situational awareness in the IDAL. Conduct IDAL laboratory risk reduction evaluations and demonstrations that evolve and			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology	PROJECT NUMBER AND TITLE 2432 Defensive System Fusion Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	optimize network EA techniques on disparate platforms. Conduct IDAL laboratory demonstrations of advanced digital receiver and processor technologies that provide the warfighter with multispectral warning, identification, and threat response for current and next generation aerospace platforms.			
(U)	In FY 2007: Continue risk reduction for defensive sensors using multiple information sources for situational awareness in the IDAL. Continue IDAL laboratory risk reduction evaluations and demonstrations that evolve and optimize network EA techniques on disparate platforms. Perform demonstrations of advanced multiplatform digital receiver and processor technologies that provide the warfighter with multispectral warning, identification, and threat response for current and next generation aerospace platforms.			
(U)				
(U)	MAJOR THRUST: Develop affordable radio frequency (RF) and electro-optical (EO) emitter warning concepts and techniques.	2.544	4.032	4.587
(U)	In FY 2005: Demonstrated affordable threat alert and jamming techniques generator technologies for combat aircraft to increase survivability against advanced, integrated RF, EO, and infrared (IR) air defense systems, including implementation of techniques to defeat future threat radar guided missile systems. Incorporated advanced jamming techniques into plans for flight demonstrations of a significantly improved digital threat warning and response capability. Developed advanced processing and encoding methods for complex emitter signals.			
(U)	In FY 2006: Design and initiate demonstration of advanced threat alert and jamming subsystem for combat aircraft to increase survivability against advanced, integrated RF, EO, and IR air defense systems. Perform initial flight tests to select advanced jamming techniques for a significantly improved digital threat warning and response capability.			
(U)	In FY 2007: Complete engineering model demonstration of advanced threat alert and jamming subsystem for combat aircraft to increase survivability against advanced, integrated RF, EO, and IR air defense systems. Perform final flight tests to validate advanced jamming techniques for a significantly improved digital threat warning and response capability.			
(U)				
(U)	CONGRESSIONAL ADD: Advanced Threat Alert ATD (Advanced Technology Demonstration) - Technology Insertion.	0.000	1.971	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Advanced Threat Alert ATD - Technology Insertion.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	7.386	7.432	5.183

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology	PROJECT NUMBER AND TITLE 2432 Defensive System Fusion Technology

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602204F, Aerospace Sensors.

(U) PE 0603203F, Advanced Aerospace Sensors.

(U) PE 0603500F, Multi-disciplinary Advanced Space Technology.

(U) PE 0604270F, Electronic Warfare (EW) Development.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603270F Electronic Combat Technology

PROJECT NUMBER AND TITLE: 431G RF Warning & Countermeasures Tech

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
431G	RF Warning & Countermeasures Tech	14.567	9.888	8.387	8.531	9.259	9.495	9.674	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced technologies for radio frequency (RF) electronic combat (EC) suites to enhance the survivability of aerospace vehicles and to provide crew situational awareness. One major area addresses technologies for missile/threat warning, RF receivers, EC preprocessors, advanced sorting/preprocessing algorithms, and expert software for applications on existing and future EC systems. Another major technology area focuses on the development and demonstration of subsystems and components for generating on-board/off-board RF countermeasure techniques. This includes the development of electronic countermeasures (ECM) techniques, as well as advanced ECM technologies such as antennas, power amplifiers, preamplifiers, etc.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop wideband, multi-mode, multi-function apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance).	3.195	1.688	1.371
(U) In FY 2005: Developed low-cost wideband and conformal, multiple polarization arrays through the use of RF-on-Flex techniques.			
(U) In FY 2006: Design and fabricate critical aperture and receiver subsystems for an efficient, low frequency, wide band aperture compatible with unmanned aerial vehicle (UAV) platforms.			
(U) In FY 2007: Test critical subsystems of an efficient, low frequency, wide band aperture, and fabricate array compatible with UAV platforms.			
(U)			
(U) MAJOR THRUST: Develop aerospace platform self-protection and support jamming technologies and techniques to counter advanced RF threats associated with current and future aerospace weapon systems.	4.772	6.228	7.016
(U) In FY 2005: Developed self-protection countermeasures effective against fourth generation surface-to-air missile systems. Conducted laboratory evaluations of countermeasures to defeat an advanced integrated air defense system (IADS). Laboratory and field-tested innovative, networked RF countermeasure techniques against advanced target engagement radars. Developed anti-jam technologies for advanced RF sensor systems.			
(U) In FY 2006: Further develop self-protection countermeasures effective against fourth generation surface-to-air missile systems. Begin development and conduct laboratory evaluations of advanced countermeasures techniques and technology to defeat an advanced IADS. Continue laboratory and field-testing of innovative, networked RF countermeasure techniques against advanced target engagement radars. Further develop anti-jam techniques and technologies for advanced RF sensor systems. Demonstrate a lightweight, low-profile, multi-function, active electronically scanned array on an airborne test bed. Analyze data from flight test and predict system performance			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology	PROJECT NUMBER AND TITLE 431G RF Warning & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	using advanced computational techniques.			
(U)	In FY 2007: Continue developing self-protection countermeasures effective against advanced future surface-to-air missile systems. Conduct further laboratory and field-testing of innovative, networked RF countermeasure techniques against advanced target engagement radars. Continue development of advanced countermeasures techniques and technology to defeat an advanced IADS. Continue developing anti-jam techniques and technologies for advanced RF sensor systems. Demonstrate electronic support cross-cueing capabilities of a multi-intelligence sensor suite including the effects of electromagnetic interference and platform compatibility to provide precision location and identification with increased probability of intercept.			
(U)				
(U)	CONGRESSIONAL ADD: Lightweight Modular Support Jammer.	5.600	0.000	0.000
(U)	In FY 2005: Developed and demonstrated a special capability high band antenna array aperture with wide bandwidth solid state power amplifiers. Developed and demonstrated a wide bandwidth jamming techniques generator. Implemented needed hardware modifications and upgrades to the system to provide high band exciter coverage. Implemented software modifications to the software system needed for demonstration of the high band electronic attack (EA) jamming subsystem. Performed an EC battle management study for distributed and networked EA.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Receiver and Processing Concepts Evaluation (RAPCEval).	1.000	0.986	0.000
(U)	In FY 2005: Expanded research in advanced RF receiver and processing algorithms using state-of-the art concepts and modern technologies.			
(U)	In FY 2006: Conduct Congressionally-directed effort for RAPCEval.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Electronic Combat Battle Management.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Electronic Combat Battle Management.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	14.567	9.888	8.387

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology	PROJECT NUMBER AND TITLE 431G RF Warning & Countermeasures Tech

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602204F, Aerospace Sensors.

(U) PE 0604270F, Electronic Warfare (EW) Development.

(U) PE 0603500F, Multi-disciplinary Advanced Space Technology.

(U) PE 0604270N, EW Development.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603270F Electronic Combat Technology	PROJECT NUMBER AND TITLE: 691X EO/IR Warning & Countermeasures Tech	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
691X	EO/IR Warning & Countermeasures Tech	15.930	16.022	10.866	11.056	11.999	12.244	12.470	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates the advanced warning and countermeasure technologies required to negate electro-optical (EO), infrared (IR), and laser threats to aerospace platforms. Off-board (decoys and expendables) and on-board countermeasure technologies developed for aircraft self-protection will provide robust, affordable solutions for protection against IR missiles with autonomous seekers, multispectral threats, laser-guided weapons, and EO and IR tracking systems used to direct EO, IR, and radar-guided missiles.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Analyze the vulnerabilities of current IR missile systems and future imaging IR sensors. Note: Increased funding in FY 2006 supports field demonstration of cooperative techniques and expendable decoys with modified spatial and kinematic properties for countering IR missiles.	2.168	4.341	1.109
(U) In FY 2005: Conducted in-house analyses on current IR-guided missile susceptibilities and future imaging IR sensors. Evaluated countermeasure techniques for countering multiple types of imaging IR sensors used for target acquisition. Developed low-cost, cooperative techniques to counter imaging IR sensors. Designed and developed expendable decoy technology with modified spatial and kinematic properties that can be used to deceive imaging IR missiles.			
(U) In FY 2006: Further conduct in-house analyses on IR-guided missile and future imaging IR sensor susceptibilities. Continue evaluating countermeasure techniques for countering multiple types of missiles and imaging IR sensors.			
(U) In FY 2007: Continue conducting in-house analyses on IR guided missiles and future imaging IR sensor susceptibilities. Further evaluate countermeasure techniques for countering multiple types of missiles and imaging IR sensors. Conduct digital simulations to assess the effectiveness of spatial decoy techniques against imaging IR missiles under flyout conditions. Assess proposed advanced countermeasure techniques to defeat imaging IR sensors.			
(U)			
(U) MAJOR THRUST: Develop aerospace laser warning sensor technologies for timely alert to advanced laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser-guided ordnance) signals.	3.667	2.020	1.850
(U) In FY 2005: Conducted risk reduction research and development for continuous wave and femto-second lasers from remote vehicles and sensors. Developed advanced eye and sensor protection cueing concepts tailored for specific			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology	PROJECT NUMBER AND TITLE 691X EO/IR Warning & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	operational deficiencies. Planned development of a laser warning sensor package for integration into unmanned aerial vehicles (UAVs) and night vision goggles (NVGs).			
(U)	In FY 2006: Initiate development of advanced laser warning receivers for aircraft. Continue developing laser warning sensor technologies to address emerging laser threats. Continue laser warning sensor packages for integration into UAVs and NVGs.			
(U)	In FY 2007: Initiate development of an advanced laser warning receiver for integration into tactical aircraft. Continue developing laser warning sensor technologies to address emerging laser threats. Initiate miniature laser warning for personnel protection.			
(U)				
(U)	MAJOR THRUST: Develop a countermeasure technology to defeat passive EO and IR aircraft tracking sensors and ordnance guidance.	4.279	2.996	7.061
(U)	In FY 2005: Demonstrated laboratory capability to locate and counter passive threats before threats can develop a fire control solution. Fabricated a testbed for field demonstrations over extended ranges.			
(U)	In FY 2006: Complete development of testbed to locate and counter passive threats before threats can develop a fire control solution. Conduct field demonstration over extended ranges to demonstrate capability. Initiate testbed integration on aircraft for flight demonstrations over full required range.			
(U)	In FY 2007: Complete integration of testbed on aircraft. Conduct flight test demonstration of the capability to locate and counter passive threats over required range before threats can develop a fire control solution.			
(U)				
(U)	MAJOR THRUST: Develop EO/IR missile warning technologies to alert aircrews and aircraft self-protection systems to the approach of advanced, low-signature threats.	1.116	0.849	0.846
(U)	In FY 2005: Performed a concept evaluation of a visible band passive warning sensor that can provide timely countermeasure initiation with high declaration probability and low false alarm rate.			
(U)	In FY 2006: Perform integration of subsystem components into affordable visible missile warning system (AVMWS). Perform test and evaluation of AVMWS. Coordinate AVMWS development with the Affordable Laser Infrared Survivability System countermeasure system.			
(U)	In FY 2007: Complete test and evaluation of AVMWS.			
(U)				
(U)	CONGRESSIONAL ADD: Detect and Avoid for UAVs.	1.400	1.380	0.000
(U)	In FY 2005: Integrated and demonstrated see and avoid wide field of regard sensor subsystem, high performance field programmable gate array processors, and detection algorithms.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Detect and Avoid for UAVs.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology	PROJECT NUMBER AND TITLE 691X EO/IR Warning & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Affordable Visible Missile Warning System.	3.300	2.070	0.000
(U)	In FY 2005: Fabricated passive, visible band missile warning subsystems for a system to provide timely countermeasure initiation with high declaration probability and low false alarm rate. Subsystems fabricated include the sensor, data processor, and detection algorithms.			
(U)	In FY 2006: Conduct Congressionally-directed effort for the Affordable Visible Missile Warning System.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Battlefield Laser Detection System (BLADES).	0.000	1.380	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for BLADES.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Infrared Countermeasures Electronics Improvement Program.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for the Infrared Countermeasures Electronics Improvement Program.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	15.930	16.022	10.866

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0604270F, Electronic Warfare (EW) Development.									
(U) PE 0603500F, Multi-disciplinary Advanced Development Space Technology.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603270F Electronic Combat Technology**	PROJECT NUMBER AND TITLE **691X EO/IR Warning & Countermeasures Tech**

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

(U) PE 0604270N, EW Development.

(U) PE 0603203F, Advanced Aerospace Sensors.

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

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0603311F
PE TITLE: Ballistic Missile Technology

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603311F Ballistic Missile Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	11.288	11.435	0.000	0.000	0.000	0.000	0.000	0.000	47.294
4091 Missile Electronics	11.288	11.435	0.000	0.000	0.000	0.000	0.000	0.000	47.294

Note: In FY 1997, the Air Force eliminated this program. However, Congress has added funds for Congressionally-directed efforts since FY 1997.

(U) A. Mission Description and Budget Item Justification

This program develops, integrates, and demonstrates advanced guidance, navigation, and control technologies for ballistic missiles, including upgrades for range safety instrumentation. In FY 2006, Congress added $8.3 million for Ballistic Missile Technology, $1.3 million for Pacific Ballistic Missile Technology Program, and $2.0 million for P-Net. 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) B. Program Change Summary ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	11.597	0.000	0.000
(U)	Current PBR/President's Budget	11.288	11.435	0.000
(U)	Total Adjustments	-0.309	11.435	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.009	-0.165	
	Congressional Increases	0.000	11.600	
	Reprogrammings			
	SBIR/STTR Transfer	-0.300		

(U) Significant Program Changes:

In FY 1997, the Air Force eliminated this program. However, Congress has added funds for Congressisonal-directed efforts since FY 1997.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603311F Ballistic Missile Technology

PROJECT NUMBER AND TITLE: 4091 Missile Electronics

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4091 Missile Electronics	11.288	11.435	0.000	0.000	0.000	0.000	0.000	0.000	47.294
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This program develops, integrates, and demonstrates advanced guidance, navigation, and control technologies for ballistic missiles, including upgrades for range safety instrumentation. In FY 2006, Congress added $8.3 million for Ballistic Missile Technology, $1.3 million for Pacific Ballistic Missile Technology Program, and $2.0 million for P-Net. 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) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) CONGRESSIONAL ADD: Ballistic Missile Technology Common Advanced Guidance Technology/Ballistic Missile Technology.	9.648	8.183	0.000
(U) In FY 2005: Developed, integrated, and demonstrated ballistic missile technologies related to advanced guidance, range safety instrumentation, and guidance sensors. Conducted development testing and evaluate the capability of innovative accelerometer, gyroscope, and flight computer instrumentation to meet performance goals at strategic radiation levels. Evaluated the performance of instruments integrated with guidance architectures that provide a robust system applicable in the most demanding missile applications. Conducted acceptance testing of existing and future integrated sensors in highly flexible and mobile range safety instrumentation.			
(U) In FY 2006: Conduct Congressionally-directed effort for Ballistic Missile Technology.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) CONGRESSIONAL ADD: Pacific Ballistic Missile Technology Program.	1.640	1.281	0.000
(U) In FY 2005: Conducted initial development, demonstratration, acceptance testing, and environmental assessment of ballistic missile range safety technologies at the Pacific Missile Range Facility in support of Air Force Space Command requirements.			
(U) In FY 2006: Conduct Congressionally-directed effort for Pacific Ballistic Missile Technology Program.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) CONGRESSIONAL ADD: P-Net.	0.000	1.971	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Conduct Congressionally-directed effort for P-Net.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	11.288	11.435	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603311F Ballistic Missile Technology	PROJECT NUMBER AND TITLE 4091 Missile Electronics

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602204F, Aerospace Sensors.

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

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0603400F
PE TITLE: J-UCAS Joint Program Office

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603400F J-UCAS Joint Program Office

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	0.000	76.691	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5067	Unmanned Combat Air Vehicle Tech Demo	0.000	76.691	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: In FY06, the Joint Unmanned Combat Air Systems (J-UCAS) program was transferred from the Defense Advanced Research Projects Agency (DARPA) to be a joint Air Force/Navy program. The J-UCAS program is being terminated and $1,830.5M is being realigned to PE0604402N in FY07-11.

(U) A. Mission Description and Budget Item Justification

The Joint Unmanned Combat Air Systems (J-UCAS) is a joint Air Force/Navy Capabilities Demonstration Program (CDP) to mature technologies to investigate the technical feasibility and operational value of unmanned combat air vehicles to provide the capability for high-threat Suppression of Enemy Air Defenses (SEAD), Electronic Attack, Strike/Persistent Ground Attack and carrier based Persistent Intelligence, Surveillance and Reconnaissance (ISR) missions. The program will demonstrate capabilities that support both Services and enable an operational system development decision in the 2012 timeframe.

The 2005 Quadrennial Defense Review (QDR) of the future force requirements for the United States military recommended termination of the J-UCAS CDP. DoD, IAW this recommendation, is terminating the J-UCAS program in FY07.

This is a BA 03 program, Advanced Technology Development, for continued development of the Boeing and Northrop Grumman demonstrator programs, and the development of common systems technology elements.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget		77.800	0.000
(U)	Current PBR/President's Budget	0.000	76.691	0.000
(U)	Total Adjustments	0.000	-1.109	
(U)	Congressional Program Reductions			
	Congressional Rescissions		-1.109	
	Congressional Increases			
	Reprogrammings			
	SBIR/STTR Transfer			

(U) Significant Program Changes:

As a result of the 2005 QDR, DoD is terminating the J-UCAS program in FY07 and realigning $1,830.5M in outyear funding to PE0604402N.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603400F J-UCAS Joint Program Office**	**5067 Unmanned Combat Air Vehicle Tech Demo**

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5067	Unmanned Combat Air Vehicle Tech Demo	0.000	76.691	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY06, the Joint Unmanned Combat Air Systems (J-UCAS) program was transferred from the Defense Advanced Research Projects Agency (DARPA) to be a joint Air Force/Navy program. The J-UCAS program is being terminated and $1,830.5M is being realigned to PE0604402N in FY07-11.

(U) A. Mission Description and Budget Item Justification

The Joint Unmanned Combat Air Systems (J-UCAS) is a joint Air Force/Navy Capabilities Demonstration Program (CDP) to mature technologies to investigate the technical feasibility and operational value of unmanned combat air vehicles to provide the capability for high-threat Suppression of Enemy Air Defenses (SEAD), Electronic Attack, Strike/Persistent Ground Attack and carrier based Persistent Intelligence, Surveillance and Reconnaissance (ISR) missions. The program will demonstrate capabilities that support both Services and enable an operational system development decision in the 2012 timeframe.

The 2005 Quadrennial Defense Review (QDR) of the future force requirements for the United States military recommended termination of the J-UCAS CDP. DoD, IAW this recommendation, is terminating the J-UCAS program in FY07.

This is a BA 03 program, Advanced Technology Development, for continued development of the Boeing and Northrop Grumman demonstrator programs, and the development of common systems technology elements.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) Continue development of J-UCAS systems, specifically the Boeing and Northrop Grumman demonstrator programs as well as the common operating system and sensors		76.691	
(U) Total Cost	0.000	76.691	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Defense-Wide RDT&E (PE0603400D8Z)	354.794	0.000	0.000	0.000	0.000	0.000	0.000		
(U) Defense-Wide RDT&E (PE0604400D8Z)	217.401	0.000	0.000	0.000	0.000	0.000	0.000		
(U) AF RDT&E (PE0604400F)	0.000	227.857	0.000	0.000	0.000	0.000	0.000		TBD
(U) NAVY RDT&E (PE0604402N)	0.000	0.000	239.000	310.000	369.400	491.100	421.000	Continuing	TBD

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603400F J-UCAS Joint Program Office**	PROJECT NUMBER AND TITLE **5067 Unmanned Combat Air Vehicle Tech Demo**

(U) D. Acquisition Strategy

Not applicable. The J-UCAS program is being terminated in FY07.

TERMINATION OF INVESTMENT-RELATED PROGRAMS

FY 2007 President's Budget

(Dollars in Millions)

PE	BPAC	APPN	FY 2005		FY 2006		FY 2007		FY 2008		FY 2009		FY 2010		FY 2011	
			COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY
0603400F	635067	3600	0.000	0	76.691	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0

Effort Title

Unmanned Combat Air Vehicle Tech Demo

Program Description

The Joint Unmanned Combat Air Systems (J-UCAS) is a joint Air Force/Navy Capabilities Demonstration Program (CDP) to mature technologies to investigate the technical feasibility and operational value of unmanned combat air vehicles to provide the capability for high-threat Suppression of Enemy Air Defenses (SEAD), Electronic Attack, Strike/Persistent Ground Attack and carrier based Persistent Intelligence, Surveillance and Reconnaissance (ISR) missions. The program will demonstrate capabilities that support both Services and enable an operational system development decision in the 2012 timeframe.

Status to Date

First flight of the X-45A took place in May 2002. In March 2004 the X-45A successfully completed an inert GPS-guided bomb demonstration and went on to demonstrate a multi-vehicle flight test in August 2004. In December 2004 the X-45A successfully demonstrated a beyond line-of-sight SATCOM handoff and a multi-vehicle taxi demonstration. The X-45A demonstration program, which included 63 test flights and 63.4 flight hours, was successfully completed in August 2005. The X-45C passed mid-term design review in December 2003, the first X-45C airframe was jig loaded in June 2004 and the Final Design Review was completed in July 2005. The first flight of the X-47A occurred in February 2003. The X-47B preliminary design review was held in March 2005 and technical baseline review occurred in October 2005.

Rationale for Termination

The 2005 Quadrennial Defense Review (QDR) of the future force requirements for the United States military recommended termination of the Joint Unmanned Combat Air Systems (J-UCAS) Capability Demonstration Program. The Department of Defense is focusing its resources on delivering required capabilities to combatant commanders and the J-UCAS CDP does not directly deliver a combat capability. Accordingly, the Department will focus on specific areas of the overall joint capabilities portfolio to deliver capability to the warfighter. The Department of the Air Force will focus resources on delivering a new long-range strike capability. The Department of the Navy will conduct an aircraft carrier demonstration of a low-observable unmanned combat air system.

PE NUMBER: 0603401F
PE TITLE: Advanced Spacecraft Technology

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	80.832	85.564	68.026	79.897	85.435	93.866	95.610	Continuing	TBD
2181	Spacecraft Payloads	31.229	28.835	19.110	25.945	28.782	30.567	31.139	Continuing	TBD
3834	Integrated Space Technology Demonstrations	15.577	24.996	26.579	29.534	32.770	36.025	36.700	Continuing	TBD
4400	Space Systems Protection	5.726	3.263	3.452	3.507	3.806	4.180	4.259	Continuing	TBD
5021	Space Systems Survivability	3.887	4.518	4.824	4.903	5.321	5.432	5.533	Continuing	TBD
5083	Ballistic Missiles Technology	5.550	5.413	3.916	3.978	4.314	4.395	4.469	Continuing	TBD
682J	Spacecraft Vehicles	18.863	18.539	10.145	12.030	10.442	13.267	13.510	Continuing	TBD

(U) A. Mission Description and Budget Item Justification

This program develops, integrates, and demonstrates space technologies in the areas of spacecraft payloads, spacecraft protection, spacecraft and launch vehicles, ballistic missiles, space systems survivability, and development of advanced laser communications technologies to support next generation satellite communication systems. The integrated space technologies are demonstrated by component or system level tests on the ground or in flight. Note: In FY 2006, Congress added $4.0 million for Large Automated Production of Expendable Launch Structure (LAPELS), $3.0 million for Intelligent Free Space Optical Satellite Communications Node, $1.2 million for Precision Integrated Navigation an Position-Intelligent Networking Technology, $4.2 million for Beta Energy Cells (BEC) for Defense and Intelligence Applications; $1.2 million for Radiation Hardening Microelectronics, $1.5 million for Alternating Current (AC) Coupled Interconnect, $1.0 million for Radially Segmented Launch Vehicle Risk Reduction, $1.0 million for Integrated Spacecraft Engineering Tool, $1.0 million for Magnetic Random-Access Memory Communications Materials, $1.4 million for Microsatellite Serial Manufacturing Process, $4.0 million for Thin Film Amorphous Solar Arrays, and $2.4 million for System Approach to Radiation Hardened Electronics. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing space system upgrades and/or new space system developments that have military utility and address warfighter needs.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	89.839	60.915	67.221
(U)	Current PBR/President's Budget	80.832	85.564	68.026
(U)	Total Adjustments	-9.007	24.649	
(U)	Congressional Program Reductions	0.000	-0.014	
	Congressional Rescissions	-0.086	-1.237	
	Congressional Increases	0.000	25.900	
	Reprogrammings	-7.207		
	SBIR/STTR Transfer	-1.714		
(U)	Significant Program Changes:			

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology

Changes to this PE since the previous President's Budget are due to higher Air Force priorities.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE: 2181 Spacecraft Payloads	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2181 Spacecraft Payloads	31.229	28.835	19.110	25.945	28.782	30.567	31.139	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project funds the development, demonstration, and evaluation of radiation-hardened space electronic hardware, satellite control hardware and software for advanced satellite surveillance operations, and development of advanced laser communications technologies to support next generation satellite communications systems. Improved space-qualifiable electronics and software for data and signal processing will be more interchangeable, interoperable, and standardized. In the near-term, this project's work concentrates on converting (i.e., radiation-hardening) commercial data and signal processor technologies for use in Air Force space systems. For mid-term applications, the Improved Space Computer Program will merge advanced, radiation-hardened space processor, memory, and interconnect technologies with commercially-derived, open system architectures to develop and demonstrate robust, on-board processing capabilities for 21st century Department of Defense satellites. In the long-term, this project area focuses on developing low-cost, easily modifiable software and hardware architectures for fully autonomous constellations of intelligent satellites capable of performing all mission related functions without operator intervention.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop spacecraft microelectronic devices, including radiation-hardened data processors and ultra-high density strategically hardened memories, space-qualifiable, high density advanced packaging technology, and micro-electro-mechanical systems (MEMS) components and applications. Note: In FY 2006, emphasis changed from microelectronics to focal plane arrays.	14.367	9.365	10.947

(U) In FY 2005: Developed inital general-purpose processor at 500 million instructions per second and digital signal processors at one million operations per second. Demonstrated electronics circuits in support of adaptable, self-repairing processors and memories enabling spacecraft capable of autonomously adapting to new missions. Built functional elements of chalcogenide-based field programmable logic and analog microelectronics. Developed hardened by design macrocell libraries enabling the use of state-of-the-art commercial manufacturing plants for high performance, low-cost electronics. Demonstrated elements for hieratical smart-wiring manifolds capable of reconfiguring entire space asset subsystems. Implemented the hardened-by-design mixed signal library and the design for analog-to-digital converter (ADC) demonstration; fabricated devices in the Silicon Germanium process. Validated performance and environmental ruggedness of the miniaturized military global positioning system (GPS) receiver through initial logic block engineering model.

(U) In FY 2006: Develop and validate the building blocks for a general-purpose processor at 500 million instructions per second. Provide the set of design tools for integrating hardening by design into commercial design tools. Fabricate a 16 megabyte chalcogenide-based nonvolatile memory. Initiate the first design hardened structured application specific integrated circuit (ASIC) to implement increased ASIC performance on low cost devices. Design and

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 2181 Spacecraft Payloads

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	fabricate the initial test vehicle to demonstrate the miniaturized military GPS receiver performance on low-cost devices.			
(U)	In FY 2007: Complete engineering model of the high performance 500 million instruction per second general-purpose processor. Fabricate a high performance design hardened analog-to-digital converter (ADC) for use in space and design a very low-power ADC using advanced design cells and design hardening. Fabricate the miniaturized military GPS receiver for use on terrestrial, aero, and space platforms. Fabricate the building blocks for a very high performance ten million-gate design hardened field programmable gate array.			
(U)				
(U)	MAJOR THRUST: Develop intelligent satellite system technologies for responsive spacecraft operations and for satellite control, precision navigation, formation flying, and proximity operations technologies for spacecraft constellations.	2.740	2.568	2.716
(U)	In FY 2005: Advanced development of command, control, and navigational capability for high fidelity spacecraft proximity operations with application to counterspace operations. Completed development of guidance, navigation, and control algorithms for proximity operations and large deployable systems. Furthered command and telemetry simulation development for mission ops center testing. Integrated hardware-in-the-loop engineering development unit into testbed, interface with spacecraft command and telemetry simulations, and performed mission ops center testing. Refined autonomous software technologies for responsive space systems. Designed integrated distributed aperture sensor analysis tool for engineering level, mission/engagement and campaign level analyses, identifying modules required for implementing unique distributed aperture sensor features to be incorporated into existing modeling and simulation tools.			
(U)	In FY 2006: Validate command and control capabilities and guidance, navigation, and control algorithms for proximity operations with flight experiment data. Refine command, control, guidance, and navigational capabilities for counterspace to apply to space situational awareness and offensive/defensive operations. Complete command and telemetry simulation development for mission ops center testing. Complete integration of hardware-in-the-loop engineering development unit into testbed, interface with spacecraft command and telemetry simulations, and conduct mission ops center testing. Build unique distributed aperture sensor simulation modules for engineering level, mission/engagement and campaign level analysis tool.			
(U)	In FY 2007: Continue to refine command, control, guidance, and navigational capabilities for counterspace to apply to space situational awareness and offensive/defensive operations. Begin to integrate autonomous flight software technologies with command, control, guidance, and navigation technologies to support responsive space systems. Extend hardware-in-the-loop testbed, spacecraft command and telemetry simulations, and mission ops center to development and testing of responsive and tactical space systems. Integrate modules and complete distributed			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 2181 Spacecraft Payloads

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
aperture sensor analysis tool for engineering level, mission/engagement and campaign level analyses.			
(U)			
(U) MAJOR THRUST: Develop modeling, simulation, and analysis tools and data exploitation methodologies for space-based surveillance systems, space capability protection technologies, access/mobility technologies, and flight experiments. Note: In FY 2006, reduction due to higher Air Force priorities.	2.043	0.682	1.213
(U) In FY 2005: Completed development of models for radio frequency (RF) system simulation. Completed development of RF signal processing models. Expanded development of simulations of space-based surveillance systems for military utility analysis. Refined development of modeling, simulation, and analysis tools for technical assessment of space capability protection and access/mobility technologies. Further developed physics-to-engineering-to-engagement level models for systems engineering, tech trades, mission planning and operations, and utility analysis applicable to potential flight experiments.			
(U) In FY 2006: Further expand development of models of surveillance systems for military utility to include tactical surveillance and electro-optical technologies. Initiate model development of responsive and reconfigurable technologies. Refine development of physics-to-engineering-to-engagement level models for systems engineering, tech trades, mission planning and operations, and utility analysis for flight experiments in tactical and responsive satellites.			
(U) In FY 2007: Complete development of models of surveillance systems for military utility to include tactical surveillance and electro-optical technologies. Continue to develop models of responsive and reconfigurable technologies. Apply physics-to-engineering-to-engagement level models for systems engineering, tech trades, mission planning and operations, and utility analysis to flight experiments in tactical and responsive satellites.			
(U)			
(U) MAJOR THRUST: Develop advanced space infrared technology and hardened focal plane detector arrays to enable acquisition, tracking, and discrimination of hot targets, as well as "cold body" targets such as decoys, satellites, and midcourse warheads.	1.472	2.142	2.669
(U) In FY 2005: Completed pathfinder, dual-band (mid-wave, long-wave) focal plane arrays (FPA) performance characterization and transition plan for insertion into a potential hyperspectral demonstration. Investigated detector array and cryogenic detector multiplexer interfacing concepts that lead to improved, larger-format, space hyperspectral imaging capabilities. Extended performance of single and dual color FPAs from moderate background levels to more stressing lower background levels needed for operation in space sensing.			
(U) In FY 2006: Initiate assessment of large format Read Out Integrated Circuits, designed through radiation hardened-by-design (RHBD), and fabricated on existing foundries. Investigate the readout and greater focal plane array performance enhancements needed for emerging detector array technologies.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 2181 Spacecraft Payloads

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Initiate studies for detectors and readouts needed for laser-based surveillance. Continue investigation into readouts fabricated on existing foundries and radiation hard design principles.			
(U)				
(U)	MAJOR THRUST: Develop technologies for multi-access laser communications space terminals with reduced weight, power, and cost for transformational communications.	1.608	2.092	1.349
(U)	In FY 2005: Explored component integration issues of multi-access laser communications systems. Completed ground breadboard testbed. Tested breadboard terminal designs in approved compatibility testbed. Developed initial multi-access laser communications terminal brassboard development.			
(U)	In FY 2006: Start development of components toward space-qualification and brassboard integration. Continue development of multi-access laser communications terminal brassboard. Start testing of components/system in relevant environmental.			
(U)	In FY 2007: Finalize brassboard integration.			
(U)				
(U)	MAJOR THRUST: Develop spectral/polarimetric sensing and data exploitation demonstrations for military imaging and remote sensing applications.	0.158	1.833	0.216
(U)	In FY 2005: Developed concepts for electro-optical/infrared spectral polarimetric space demonstrations. Examined hardware issues and begin technology development plan. Developed initial polarimetric FPA technology.			
(U)	In FY 2006: Complete polarimetric FPA test article and validate performance. Integrate FPA into laboratory camera and collect high quality data in the laboratory of relevant materials.			
(U)	In FY 2007: Conduct field collection with polarimetric focal plane camera. Demonstrate feasibility of hardware design for transition to acquisition system.			
(U)				
(U)	CONGRESSIONAL ADD: Alternating Current (AC) Coupled Interconnect.	0.971	1.478	0.000
(U)	In FY 2005: Demonstrated the ability of an AC-coupled interconnect approach to be used in connecting two different parts of a complex system (i.e., third-level packaging.) Under this assumption, optimized the design of the interconnect to maximize signal transport efficiency and minimize the bit error rate due to misalignment and multiple mating cycles.			
(U)	In FY 2006: Conduct Congressionally-directed effort for AC Coupled Interconnect.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Magnetoresistive Random Access Memory (MRAM) Innovative Communications Materials/Magnetic Random-Access Memory Communications Materials.	1.165	0.986	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 2181 Spacecraft Payloads

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2005: Integrated MRAM cells, which are intrinsically radiation-hard, with RHBD microelectronics, leading to embedded memories for spacecraft systems that are more immune to single event upset effects from high energy particles. Supported an unlimited number of read-write cycles with ten nanoseconds access time, while consuming less than a nonowatt per bit.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Magnetic Random-Access Memory Communications Materials.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Advanced Life Cycle Cost (LCC)/Risk Model for Space Concept Development.	0.971	0.000	0.000
(U)	In FY 2005: Incorporated Space concept cost modeling processes and methodologies into a software modeling and simulation code, the Advanced LCC/Risk Estimating Tool, which were incorporated into an existing modeling and simulation tool to provide integrated design, analysis, and LCC/risk estimating.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Systematic Hierarchical Approach to Radiation Hardened Electronics/System Approach to Radiation Hardened Electronics.	1.458	2.366	0.000
(U)	In FY 2005: Developed RHBD process design kits (PDKs). PDKs are targeted at commercial, on-shore integrated circuit (IC) fabrication processes. Verified proper operation of PDKs against RHBD ICs generated for DoD space applications such as GPS receiver ICs. Fabricated and characterized radiation response of RHBD IC test chips and validate radiation characterization data versus simulated results. Provided standardized PDKs for the design phase of radiation hardened ICs. Provided accelerated potential for qualified, automated generation of hardened ICs during production phase.			
(U)	In FY 2006: Conduct Congressionally-directed effort for System Approach to Radiation Hardened Electronics.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Radiation Hardened Microelectronics.	1.360	1.183	0.000
(U)	In FY 2005: Developed and demonstrated next-generation electronics technology for reconfigurable DoD space systems applications using both design and process hardening techniques. Showed that an emerging a commercial electronics memory design can be rapidly transitioned to DoD space applications by taking advantage of the improved hardened fabrication industrial infrastructure and by modifying the design to harden against both natural and man-made radiation. Demonstrated sizes as low as 0.15 microns.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 2181 Spacecraft Payloads

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Conduct Congressionally-directed effort for Radiation Hardened Microelectronics.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADDS: Intelligent Free Space Optical Communications and Intelligent Free Space Optical Satellite Communications Node.	2.916	2.957	0.000
(U)	In FY 2005: Developed engineering model intra-satellite fiber optic communications network components, high speed, multi-channel, gimble-less inter-satellite free space optical communications transceivers, and intelligent/adaptive intra-satellite switching and routing components with initial space pre-qualification testing.			
(U)	In FY 2007: Conduct Congressionally-directed effort for Intelligent Free Space Optical Satellite Communications Node.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Precision Integrated Navigation and Position-Intelligent Networking Technology.	0.000	1.183	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Precision Integrated Navigation and Position-Intelligent Networking Technology.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	31.229	28.835	19.110

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0303601F, MILSTAR Satellite Communications System.									
(U) PE 0305160F, Defense Meteorological Satellite Program (DMSP).									
(U) PE 0602601F, Spacecraft Technology.									
(U) PE 0603311F, Ballistic Missile									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603401F Advanced Spacecraft Technology**	PROJECT NUMBER AND TITLE **2181 Spacecraft Payloads**

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

Technology.

(U) PE 0603215C, Limited Defense System.

(U) PE 0603218C, Research and Support.

(U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.

(U) PE 0604609F, Reliability and Maintainability Technology Insertion Program (RAMTIP).

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE: 3834 Integrated Space Technology Demonstrations

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3834	Integrated Space Technology Demonstrations	15.577	24.996	26.579	29.534	32.770	36.025	36.700	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project is a series of advanced technology demonstrations designed to address mission needs by applying emerging technologies from the Air Force Research Laboratory, other Government laboratories, and industry. These technologies are integrated into system-level demonstrations that are used to test, evaluate, and validate the technologies in an relevant environment.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop microsatellite (10-100Kg) technologies for integrated, robust, flexible, microsatellite demonstrations building on previous work and leveraging investments by other organizations. Applications include space-based space situational awareness and/or tactical satellite concepts. Note: In FY 2005, reduction is due to higher Air Force priorities.	10.720	21.644	26.579
(U) In FY 2005: Completed environmental testing. Completed development of autonomous proximity operations microsatellites ground control interface system. Performed real-time hardware-in-the-loop and software-in-the-loop mission experiments and testing beyond spacecraft envelope. Completed satellite/launch vehicle integration and launch. Performed mission operations around several non-cooperative resident space objects. Evaluated options for potential follow-on space situational awareness technology demonstration, using operational concept trades. Performed preliminary design concept trades and initial satellite design(s). Downselected to best payload option. Designed initial satellite bus. Completed preliminary bus and payload design.			
(U) In FY 2006: Complete autonomous flight demonstration. Perform de-orbit maneuver. Complete satellite design(s). Initiate procurement of bus and payload hardware. Begin fabrication of payload and bus. Develop and test ground control system for real-time planning of flight operations of situational awareness missions. Develop and test flight software. Perform simulated missions against simulated faults and anomalies.			
(U) In FY 2007: Complete payload and bus fabrication. Perform functional and environmental tests of payload and bus. Complete system level integration of payload and microsatellite and complete functional and environmental tests of integrated system. Begin integration with launch vehicle. Integrate ground control system and satellite software simulations. Perform simulated mission operations for missions operations training.			
(U)			
(U) CONGRESSIONAL ADD: Integrated Spacecraft Engineering Tool (ISET).	0.971	0.986	0.000
(U) In FY 2005: Expanded tool to predict performance benefits and impacts for new technologies on a variety of			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 3834 Integrated Space Technology Demonstrations

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	spacecraft, spacelift, and responsive force systems. This includes unique subject areas such as satellite field-of-view studies, space radiation effects, directed energy lethality and vulnerability, and implementation of hardware-in-the-loop simulation.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Integrated Spacecraft Engineering Tool (ISET).			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Vehicle Risk Reduction/Radially Segmented Launch Vehicle Risk Reduction.	3.886	0.986	0.000
(U)	In FY 2005: Completed fabrication of all tank body component and assembly tools, fabrication of all tank body sections, fabrication of the structural test fixture, structural testing of the bodies, and fabrication of the tank dome component tools. Fabricated initial tank assembly tools and the remaining tanks.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Microsatellite Serial Manufacturing Process.	0.000	1.380	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Microsatellite Serial Manufacturing Process.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	15.577	24.996	26.579

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602601F, Spacecraft Technology.

(U) PE 0603605F, Advanced Weapons Technology.

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

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603401F Advanced Spacecraft Technology**	PROJECT NUMBER AND TITLE **3834 Integrated Space Technology Demonstrations**

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE: 4400 Space Systems Protection	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4400 Space Systems Protection	5.726	3.263	3.452	3.507	3.806	4.180	4.259	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates tools, instruments, and mitigation techniques required to assure operation of U.S. space assets in potentially hostile warfighting environments. The project performs assessments of critical components and subsystems, and evaluates susceptibility and vulnerability to RF and laser threats. This project also develops technologies that mitigate identified vulnerabilities. Technologies are developed and demonstrated to support balanced satellite protection strategies for detecting, avoiding, and operating in a hostile space environment.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Use multi-threat assessment tools to assess space-based electro-optical, communication, and other responses to various candidate RF and laser countermeasures and directed energy threats.	0.641	0.876	0.947
(U) In FY 2005: Investigated models for RF and laser response in communications and power subsystems and integration into single satellite communications and power subsystem models into satellite constellation analysis tool. Applied constellation analysis tool to wargaming exercises and assess efficacy.			
(U) In FY 2006: Perform predicative analysis of laboratory data to validate models being developed for the satellite constellation analysis tool. Begin modeling of mitigation techniques and incorporate into constellation analysis tool.			
(U) In FY 2007: Verify mitigation models against test data and commence predictive analysis of technique effectiveness.			
(U)			
(U) MAJOR THRUST: Develop passive satellite countermeasures and mitigation techniques for current and future threats to satellites.	1.249	2.014	2.101
(U) In FY 2005: Investigated and identified candidate threat mitigation technologies for principle satellite subsystems, such as shielding and terminal protection techniques for multi-chip modules, reconfigurable processors/architectures, and anti-jam modems for uplink subsystems.			
(U) In FY 2006: Develop prospective threat technologies and initiate comprehensive testing for space application.			
(U) In FY 2007: Integrate protection into space experiment for demonstration and validation.			
(U)			
(U) MAJOR THRUST: Develop visible and near-infrared laser protection technologies.	0.435	0.373	0.404
(U) In FY 2005: Designed and fabricated an optical sensor subsystem incorporating adaptive signal processing techniques. Developed optical sensor subsystem threat mitigation techniques using solutions such as acousto-optical switches or other developed limiters to deflect incoming laser energy from the focal plane array.			
(U) In FY 2006: Demonstrate visible and near-infrared laser protection technologies. Conduct ground test of optical			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 4400 Space Systems Protection

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	sensor subsystem incorporating selective mitigation approaches. Develop selected protection techniques and evaluate effectiveness as a laser mitigation technique of optical sensor subsystems. Coordinate space simulation testing of prospective protection technology.			
(U)	In FY 2007: Coordinate space demonstration of protective technology. Identify technology transfer opportunities and report findings to major commands.			
(U)				
(U)	CONGRESSIONAL ADD: Hardening Technologies for Satellite Protection.	3.401	0.000	0.000
(U)	In FY 2005: Evaluated possible protection techniques that are acceptable to systems designers with a goal of minimum impact of additional weight and power, integration issues, and performance loss. Maintained relationship with commercial systems designers to explore acceptable approaches for application to commercial systems. Expanded laboratory testing of prospective protection techniques, filters, rugates, and/or limiters applicable for enhanced survivability. Developed promising protection techniques emerging from FY 2004 effort. Developed inital field tests of the most promising protection techniques. Incorporated test results and feed back from commercial systems designers into the Satellite Survivability Module code.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	5.726	3.263	3.452

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602102F, Materials.									
(U) PE 0602601F, Spacecraft Technology.									
(U) PE 0603605F, Advanced Weapons Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603401F Advanced Spacecraft Technology**	PROJECT NUMBER AND TITLE **4400 Space Systems Protection**

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE: 5021 Space Systems Survivability	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5021 Space Systems Survivability	3.887	4.518	4.824	4.903	5.321	5.432	5.533	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates technologies to improve space system survivability and reliability of current and future Department of Defense space systems that must continue operation despite natural space hazards. It develops and demonstrates cost-effective solutions to mitigate hazardous space environmental interactions including electrical charge buildup and electronics failures due to both single radiation events and long-term radiation doses.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop sensors to specify and forecast conditions in the space environment that degrade the operation of satellite, communication, navigation, and surveillance systems. Support integration, launch, validation, and operation of instrumentation to provide improved space radiation and ionospheric hazard specification and forecasting.	2.633	3.215	3.685
(U) In FY 2005: Completed initial all-sky image based solar disturbance forecast algorithms and transition to military/civilian operational forecasters. Further developed relativistic particle sensor for Air Force radiation belt mapping satellite. Investigated joint-agency development of miniaturized plasma, magnetic field, and all-sky white light cameras for inclusion on interplanetary microsatellites. Determined optimal micro- and nano-technology path to achieve maximum deployable, highest capability energetic particle, neutral density, and low-energy plasma sensors for space weather characterization.			
(U) In FY 2006: Calibrate and integrate relativistic particle sensor onto Air Force radiation belt mapping satellite. Complete concept design for joint-agency space-based coronagraph and heliospheric imager for next-generation solar hazard detection system. Initiate concept design of micro- and nano-technology sensors for energetic particle, neutral density, low-energy plasma space weather characterization.			
(U) In FY 2007: Complete integration of relativistic particle sensor onto Air Force radiation belt mapping satellite. Identify space test opportunity and begin construction of joint agency coronagraph and heliospheric imager for solar hazard detection. Complete concept design of next-generation miniaturized space weather sensors and begin development of engineering models.			
(U)			
(U) MAJOR THRUST: Conduct collaborative space and laboratory experiments and develop hardware and software tools to improve the survivability of spacecraft power, communications, navigation, and surveillance systems.	0.315	0.353	0.371
(U) In FY 2005: Completed design and laboratory testing of miniaturized geosynchronous charge control system and explore options for on-orbit demonstration of hazard mitigation. Refined space tether experiment concept and			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 5021 Space Systems Survivability

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	finalize space hardware requirements. Completed integration of ionospheric and satellite drag effects into spacecraft environment effect tool suite. Completed hardware suite selection and begin fabrication of payload for space experiment to actively explore space particle dynamics and demonstrate radiation belt remediation technologies.			
(U)	In FY 2006: Develop space plasma control experiment plan combining satellite charge control and tether propulsion and particle remediation concepts. Begin integration of dynamic space particle climatology and radiation belt forecast models into spacecraft environment effect tool suite. Continue fabrication of payload to demonstrate radiation belt remediation technologies using electromagnetic wave technologies.			
(U)	In FY 2007: Construct space plasma control experiment payload and establish joint-agency collaboration for spaceflight. Continue expansion of spacecraft environment effect tool suite to include dynamic space particle climatologies and forecast models. Complete radiation belt remediation payload and begin calibration and integration onto Air Force test satellite.			
(U)				
(U)	MAJOR THRUST: Develop technology to warn of spacecraft radiation, charging, and kinetic impact hazards and to provide space environment situational awareness and anomaly resolution capability for Department of Defense space systems.	0.939	0.950	0.768
(U)	In FY 2005: Advanced global radiation hazard situational awareness model development by expanding number of sensor inputs to improve accuracy and timeliness. Completed laboratory demonstrations of distributed space hazard sensors needed for space situational awareness. Completed design of active wave experiment to remediate severe radiation environments. Planned for space test flight of active wave and distributed sensor technologies.			
(U)	In FY 2006: Develop filter-based optimization algorithms to determine full particle energy spectra utilizing complete inputs available from compact environment anomaly sensor. Determine impact sensor design and finalize requirements and conceptual design of radiation, plasma, chemical, and impact effect distributed anomaly resolution and spacecraft effects sensor suite. Complete construction of compact environment anomaly sensor to diagnose severe radiation environments expected during active wave radiation belt remediation experiment.			
(U)	In FY 2007: Employ full energy spectra algorithms to convert entire compact environment anomaly sensor data bases into dynamic climatological model for anomaly resolution and space system design. Commence construction of hardware for space demonstration of the distributed anomaly resolution sensor. Calibrate and integrate compact environment anomaly sensor for diagnosing severe radiation environment on Air Force test satellite.			
(U)	Total Cost	3.887	4.518	4.824

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603401F Advanced Spacecraft Technology**	PROJECT NUMBER AND TITLE **5021 Space Systems Survivability**

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(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.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE: 5083 Ballistic Missiles Technology	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5083 Ballistic Missiles Technology	5.550	5.413	3.916	3.978	4.314	4.395	4.469	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops, integrates, and demonstrates advanced technologies for sustainment and modernization of strategic ballistic missiles. The project focuses on developing robust, low maintenance inertial navigation instruments to sustain current ballistic missile systems, as well as provide new, small, low-powered, high precision instrumentation for next generation missile systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop, integrate, and demonstrate advanced navigation instrumentation applied to emerging vehicle designs and other technologies that sustain current strategic missile systems. Provide critical missile technology concepts to support future space force application and strategic systems.	2.775	2.707	1.958
(U) In FY 2005: Downselected to the most advanced navigational instrumentation designs for the next generation of ballistic missiles. Evaluated the designs and provide improvements to meet the established performance goals. Demonstrated and validated improved navigational technology designs that can meet performance goals.			
(U) In FY 2006: Explore further laboratory proof-of-concept of the most promising next generation missile navigation instrumentation designs. Initiate fabrication of navigation instruments and engineering demonstration units. Initiate engineering development tests. Evaluate instrument performance and provide improvements to meet established performance goals.			
(U) In FY 2007: Develop and integrate engineering design next generation missile navigation systems and ground test in environments relevant to subsequent flight test conditions. Evaluate system performance and provide improvements to meet established performance goals. Initiate flight test demonstration planning.			
(U)			
(U) MAJOR THRUST: Develop, integrate, and demonstrate advanced navigation technologies with new vehicle designs to provide robust, flexible, lower cost solutions for sustaining current strategic missile systems.	2.775	2.706	1.958
(U) In FY 2005: Completed advanced thermal materials design integrated with long-glide vehicles to provide greater controllability and selective targeting. Evaluated demonstration results of advanced leading edge and control surface materials and initiated down selection to candidates projected to provide lower cost, robust advanced future vehicle designs. Used results of laboratory testing to improve the capability of on-board navigation instruments and range safety devices to withstand loads greater than 100 times the gravitational force in all axes in flight test demonstrations.			
(U) In FY 2006: Initiate long-term plan for sled testing of high-gravitational force tolerant navigation instrumentation			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 5083 Ballistic Missiles Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	and range safety devices. Characterize instrumentation performance in quiescent environments. Initiate system level design interfaces with experimental test bed.			
(U)	In FY 2007: Continue long-term planning and initiate long-lead hardware acquisition and coordination with test facilities in preparation for sled testing of high-gravitational force tolerant navigation instrumentation and range safety devices. Measure performance of navigation instrumentation and range safety devices with associated platform hardware, power sources, support software, and communication interfaces in 100 times the gravitational force flight-like vibration environments. Continue system level design interfaces experimental test bed.			
(U)	Total Cost	5.550	5.413	3.916

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0601102F, Defense Research Sciences.									
(U) PE 0602601F, Space Technology.									
(U) PE 0603311F, Ballistic Missile Technology.									
(U) PE 0603601F, Conventional Weapons Technology.									
(U) PE 0603851F, Intercontinental Ballistic Missile-Dem/Val.									
(U) PE 0604851F, Intercontinental Ballistic Missile-EMD.									
(U) PE 0605860F, Rocket System Launch Program-Space.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE: 682J Spacecraft Vehicles	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
682J Spacecraft Vehicles	18.863	18.539	10.145	12.030	10.442	13.267	13.510	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates compact, low-cost, spacecraft and launch vehicle power generation, storage, distribution, and thermal management technologies, including cryogenic cooling technologies. Power generation activities focus on lightweight, low-cost, low-volume, and survivable solar cell arrays. Energy storage work focuses on lightweight nickel hydrogen and sodium sulfur spacecraft batteries and flywheel energy storage systems for extended (five to ten year) satellite missions. The project's power distribution efforts focus on producing lightweight, high-efficiency, standardized power busses for use on future space systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Developed and evaluated performance of space conventional power generation technologies such as multi-junction solar cells, advanced thin film solar cells, lightweight flexible solar cell arrays, and radiation resistant solar cell modules.	1.541	1.583	2.266
(U) In FY 2005: Demonstrated methods for interconnecting thin-film solar modules into array-sized thin-film blankets. Demonstrated first six junction solar cell producing voltage twice that of state of the art triple junction solar cells.			
(U) In FY 2006: Complete space environmental testing of thin-film solar cells and modules. Perform radiation testing of lattice mismatch multi-junction solar cells.			
(U) In FY 2007: Perform radiation testing of five to six junction solar cells. Construct flight hardware for thin-film solar array. Demonstrate roll-to-roll production of thin-film solar cells on polymer substrates.			
(U)			
(U) MAJOR THRUST: Develop technologies for long life, efficient, low-vibration, lightweight mechanical cryocoolers and integration components for space applications.	0.862	1.031	1.488
(U) In FY 2005: Refined development of high capacity, multi-stage, low-temperature cryocooler technologies to meet the needs of high resolution, space-based infrared surveillance and tracking sensors with larger focal planes and optics. Expanded development of component cryocooler technologies for regenerative and recuperative cycle devices to transition enabling technology to cryocooler designs. Demonstrated cryogenic integration technologies, including thermal switches, in a relevant environment.			
(U) In FY 2006: Complete development of low temperature flight qualified high capacity cryocooler and demonstrate performance of cryocooler and control electronics integrated with focal plane in a relevant environment. Improve performance of key critical components including compressor, electronics, and heat exchangers.			
(U) In FY 2007: Assess various advanced technologies such as micro-electro-mechanical, optical cooling, and other concepts to further reduce cryocooler mass and improve performance for space based situational awareness			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 682J Spacecraft Vehicles

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	applications. Initiate advanced concept development program to support multi-temperature and large focal plane cooling requirements for space-based space surveillance and other mission applications.			
(U)				
(U)	MAJOR THRUST: Develop composites for launch vehicle and spacecraft structures and space applications, such as launch vehicle shrouds, thermal protection structures, and space antennas.	1.810	1.945	3.369
(U)	In FY 2005: Further refined spacecraft to demonstrate multi-functional structures technologies. Ground demonstrated sub-scale linerless composite cryogenic tanks. Fabricated and characterized components for large deployable optics systems using nanotechnology-enhanced materials.			
(U)	In FY 2006: Develop ultra-lightweight, high-structural efficiency mirror support structures for space mirrors. Demonstrate qualification-level performance of all-composite payload adapters and fairing structures for Evolved Expendable Launch Vehicles.			
(U)	In FY 2007: Demonstrate space qualification-level performance for large diameter launch vehicle fairing. Transition multi-functional structures technology to unmanned aerial vehicle and launch vehicle community. Demonstrate space qualification-level performance for 25-meters long ultralightweight deployable structures.			
(U)				
(U)	MAJOR THRUST: Develop technologies for spacecraft structural controls and mechanisms for on-orbit applications such as advanced high power solar array subsystems, sensitive payload isolation systems, and miniature payload isolation systems.	2.020	1.954	3.022
(U)	In FY 2005: Refined launch vibration isolation and primary and secondary payload isolation systems to meet specific launch vehicle requirements. Completed development of operational active acoustic attenuation systems. Completed development of low-shock multiple payload adapter technologies. Performed flight qualification testing of smart docking and deployment hardware. Integrated micro-electro-mechanical attitude control components with conventional attitude control systems.			
(U)	In FY 2006: Develop rapid-slew, fast tracking gimbal technology to allow sub-orbital space situational awareness missions. Demonstrate space qualification-level performance for miniaturized vibration isolation systems for optical payloads.			
(U)	In FY 2007: Ground demonstrate full multi-axis flywheel attitude control system with integrated energy storage. Demonstrate space qualification-level performance for passive vibro-acoustic damping devices to mitigate launch vehicle acoustic loads. Flight demonstrate on-orbit docking and fluid transfer mechanisms.			
(U)				
(U)	CONGRESSIONAL ADD: Thin Film Amorphous Solar Arrays.	7.286	3.943	0.000
(U)	In FY 2005: Demonstrated monolithic integration of amorphous silicon solar cells in roll-to-roll processing.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 682J Spacecraft Vehicles

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Demonstrated process capable of high volume, roll-to-roll production of amorphous silicon solar cells on polymer substrates.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Thin Film Amorphous Solar Arrays.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Robust Aerospace Composite Materials/Structures.	4.373	0.000	0.000
(U)	In FY 2005: Fabricated full-scale fairings and adapters based on design inputs from FY 2004 and supporting Small Business Innovation Research contracts for new structure fabrication processes and fairing/adapter configurations. Demonstrated large scale out-of-autoclave component fabrications. Investigated influence on practical controlled flaws and performance. Tested structures to failure to demonstrate degree of conservatism in current design practices. Fairing designs up to ten meters in diameter to support large optics experiments will be considered for this demonstration program.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Boron Energy Cell Development/Beta Energy Cells (BEC) for Defense and Intelligence Applications.	0.971	4.140	0.000
(U)	In FY 2005: Integrated Boron Energy Cell with battery and capacitor storage device to provide Boron Energy Cell Storage Packs capable of supplying burst power for selected high value Air Force applications. Increased conversion efficiency of devices from 1% to 10%.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Beta Energy Cells (BEC) for Defense and Intelligence Applications.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Large Automated Production of Expendable Launch Structure (LAPELS).	0.000	3.943	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Large Automated Production of Expendable Launch Structure (LAPELS).			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	18.863	18.539	10.145

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 682J Spacecraft Vehicles

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602203F, Aerospace Propulsion.

(U) PE 0602601F, Spacecraft Technology.

(U) PE 0603218C, Research and Support.

(U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

PE NUMBER: 0603444F
PE TITLE: MAUI SPACE SURVEILLANCE SYSTEM

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603444F MAUI SPACE SURVEILLANCE SYSTEM

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	56.561	47.166	6.074	6.173	6.699	6.838	6.966	Continuing	TBD
4868 Maui Space Surveillance System	56.561	47.166	6.074	6.173	6.699	6.838	6.966	Continuing	TBD

(U) A. Mission Description and Budget Item Justification

This program funds space situational awareness technology development and demonstration at the Maui Space Surveillance System (MSSS) in Hawaii, as well as the operation and upgrade of the facility. Note: In FY 2006, Congress added $22.0 million for MSSS Operations and Research, $10.0 million for High Accuracy Network Determination System (HANDS), and $10.0 million for the Panoramic Survey telescope and Rapid Response System (Pan-STARRS). This program is in Budget Activity 3, Advanced Technology Development, since it enables and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	58.189	5.848	6.005
(U)	Current PBR/President's Budget	56.561	47.166	6.074
(U)	Total Adjustments	-1.628	41.318	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.045	-0.682	
	Congressional Increases		42.000	
	Reprogrammings	-0.096		
	SBIR/STTR Transfer	-1.487		
(U)	Significant Program Changes:			

Not Applicable.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603444F MAUI SPACE SURVEILLANCE SYSTEM	PROJECT NUMBER AND TITLE: 4868 Maui Space Surveillance System	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4868 Maui Space Surveillance System	56.561	47.166	6.074	6.173	6.699	6.838	6.966	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This program funds space situational awareness technology development and demonstration at the Maui Space Surveillance System (MSSS) in Hawaii, as well as the operation and upgrade of the facility. Note: In FY 2006, Congress added $22.0 million for MSSS Operations and Research, $10.0 million for High Accuracy Network Determination System (HANDS), and $10.0 million for the Panoramic Survey telescope and Rapid Response System (Pan-STARRS). This program is in Budget Activity 3, Advanced Technology Development, since it enables and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop, demonstrate, and integrate space situational awareness technology at the Maui Space Surveillance System (MSSS) in Hawaii, as well as operate and upgrade the facility. Note: This effort includes Congressional Adds of $22.0 million in FY 2006.	38.224	27.450	6.074
(U) In FY 2005: Enhanced MSSS utility by procuring critical sensor and telescope spares, refurbishing the control rooms and upgrading computers for increased personnel efficiency, and maintaining requirements for safety and security in accordance with Air Force regulations. Researched current and new, advanced technologies for improving active track of satellite and missile tests. Refined active imaging technology along with adaptive optics and image post-processing algorithms as well as techniques to assess when further processing is no longer productive. Pursued non-imaging space object identification techniques to determine how shape and size information can be extracted from non-imaging signature information.			
(U) In FY 2006: Continue MSSS operations, research, and development supporting various operational customers and experimenters. Procure additional critical sensor and telescope spares, continue to refurbish the control rooms and upgrade computers for increased efficiency, while maintaining requirements for safety and security in accordance with Air Force regulations.			
(U) In FY 2007: Continue MSSS research, development, and operational contributions supporting various customers and experimenters. Continue refurbishing and upgrading MSSS, and maintaining requirements for safety and security in accordance with Air Force regulations. Develop concepts for space situational awareness, space system characterization and active tracking. Lead and shape the development of system requirements for Congressional and customer funded programs.			
(U)			
(U) CONGRESSIONAL ADD: Panoramic Survey Telescope And Rapid Response System (Pan-STARRS).	9.912	9.858	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603444F MAUI SPACE SURVEILLANCE SYSTEM	PROJECT NUMBER AND TITLE 4868 Maui Space Surveillance System

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2005: Performed site selection and ground-breaking activities. Fabricated and assembled first PanSTARRS telescope, which will be located on Haleakala, HI. Investigated satellite streak issue for dim object detections. Evaluated the PanSTARRS system for its military utility and completed development of focal plane arrays for use in the four-telescope system.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Pan-STARRS.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: High Accuracy Network Determination System (HANDS).	8.425	9.858	0.000
(U)	In FY 2005: Deployed additional HANDS sensors, both narrow field of view and mid-field of view, to expand global coverage of the geosynchronous earth orbit belt, advancing state-of-the-art space situation awareness technology. Developed the areas of improving satellite metrics accuracy, low earth orbit sensors, and meter-class sensors.			
(U)	In FY 2006: Conduct Congressionally-directed effort for HANDS.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	56.561	47.166	6.074

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602605F, Directed Energy Technology.									
(U) PE 0603605F, Advanced Weapons Technology.									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.									
(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603444F MAUI SPACE SURVEILLANCE SYSTEM**	PROJECT NUMBER AND TITLE **4868 Maui Space Surveillance System**

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

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

(U) D. Acquisition Strategy

Not Applicable.

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

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

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

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	47.676	55.732	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5031	Advanced Optics & Laser Space Tech	15.459	22.644	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5033	Rocket Propulsion Demonstration	25.058	25.972	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5034	Advanced Space Sensors	7.159	7.116	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: Funds for the FY 2006 Congressionally-directed Aerospace Relay Mirror System in the amount of $2.1 million are in the process of being moved to PE 0603605F, High Energy Laser Technology, Project 3647, from this PE for execution. In FY 2007, Project 5031, efforts transfer to PE 0603605F, Project 6311SP, Advanced Optics and Laser Space Technology; Project 5032, efforts transfer to PE 0603112F, Advanced Materials for Weapons Systems, Project 6377SP, Advanced Space Materials; Project 5033, efforts transfer to PE 0603216F, Aerospace Propulsion and Power Technology, Project 6310SP, Space Rocket Propulsion Demonstration; Project 5034, efforts transfer to PE 0602203F, Advanced Aerospace Sensors, Project 6388SP, Advanced Space Sensors; and Project 5062, efforts transfer to PE 0603211F, Aerospace Technology Development/Demonstration, Project 6399SP Advanced Structures Space Vehicles, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates multi-disciplinary space technologies focusing on separate technology areas including: 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; and 5) advanced structures for space vehicles develop space unique requirements for a horizontally launched transatmospheric vehicle operating in an extreme environment. Note: In FY 2006, Congress added $2.1 million for Aerospace Relay Mirror System and $1.0 million for Upper Stage Engine Technology (USET). This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing space system upgrades and/or new space system developments that have military utility and address warfighter needs.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	56.908	53.437	68.586
(U)	Current PBR/President's Budget	47.676	55.732	0.000
(U)	Total Adjustments	-9.232	2.295	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.044	-0.805	
	Congressional Increases		3.100	
	Reprogrammings	-7.830		
	SBIR/STTR Transfer	-1.358		

(U) Significant Program Changes:

Efforts transfer to other programs in FY07 and out to more effectively manage and provide oversight of the efforts. Other changes to this PE since the Previous President's Budget are due to higher Air Force priorities.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE: 5031 Advanced Optics & Laser Space Tech

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5031 Advanced Optics & Laser Space Tech	15.459	22.644	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the FY 2006 Congressionally-directed Aerospace Relay Mirror System in the amount of $2.1 million are in the process of being moved to PE 0603605F, High Energy Laser Technology, Project 3647, from this PE for execution. In FY 2007, efforts transfer to PE 0603605F, Advanced Weapons Technology, Project 6311SP, Advanced Optics and Laser Space Technology, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project provides for the demonstration and detailed assessment of space unique technologies needed for advanced optical systems and high-energy laser weapons.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop advanced, long-range, optical technologies such as advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large, lightweight optics; and optical coatings that support relay mirror systems. Relay mirror systems can greatly extend the range of high-power laser weapons, as well as low-power imaging systems. .	2.962	3.016	0.000
(U) In FY 2005: Demonstrated dual line-of-sight tracking technology by tracking a satellite with a relay mirror. Completed the construction of and test the optical quality of a two kilogram per square meter ultra-lightweight mirror.			
(U) In FY 2006: Plan a demonstration to actively track a cruise missile by relaying both the illuminator and the scoring beam through the relay and differentially pointing them at the output. Demonstrate the ability to apply advanced high energy laser (HEL) optical coatings on a three-meter diameter substrate such as lightweight SiC primary mirrors. Design and build a lightweight mirror/micro electro-mechanical system integration test bed for the evaluation of advanced optical components.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Perform atmospheric compensation/beam control experiments for applications including antisatellite weapons, relay mirror systems, satellite tests and diagnostics, and high-resolution satellite imaging.	3.726	4.857	0.000
(U) In FY 2005: Completed integration and begin testing of sodium-beacon adaptive optics system including compensated infrared imaging of low earth orbit (LEO) satellites.			
(U) In FY 2006: Begin testing of advanced laser-beacon adaptive optics system on Starfire Optical Range (SOR) 3.5 meter telescope to increase imaging resolution/laser beam control. Perform high-resolution satellite imaging at short wavelengths. Demonstrate and characterize performance of point-ahead compensated laser propagation to LEO satellites using sodium-beacon adaptive optics.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5031 Advanced Optics & Laser Space Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate advanced optical beam control technologies for laser propagation through severe and/or extended atmospheric turbulence.	8.771	12.701	0.000
(U)	In FY 2005: Commenced fabrication of ground test equipment for field characterization of laser propagation through atmospheric turbulence. Developed initial advanced adaptive optical and tracking technologies for reliable operation in stressing atmospheric conditions.			
(U)	In FY 2006: Complete integration of first phase ground test system for characterization of laser propagation through atmospheric turbulence. Complete laboratory experiments and begin field testing of advanced adaptive optical and tracking technologies in stressing atmospheric conditions.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Aerospace Relay Mirror System.	0.000	2.070	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Demonstrate an integrated, multi-mission capability of high-energy laser and relay system.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	15.459	22.644	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602605F, Directed Energy Technology.									
(U) PE 0603444F, Maui Space Surveillance System.									
(U) PE 0603605F, Advanced Weapons Technology.									
(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5031 Advanced Optics & Laser Space Tech

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

eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE: 5033 Rocket Propulsion Demonstration

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5033 Rocket Propulsion Demonstration	25.058	25.972	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0603216F, Aerospace Propulsion and Power Technology, Project 6310SP, Space Rocket Propulsion Demonstration, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced and innovative low-cost rocket turbomachinery and components, low-cost space launch propulsion system technologies, and advanced propellants for launch and orbit transfer propulsion. Additionally, this project develops technologies for the Technology for Sustainment of Strategic Systems Phase 1. Characteristics such as environmental acceptability, affordability, reliability, responsiveness, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. This project also develops chemical, electrical, and solar rocket propulsion system technologies for stationkeeping and on-orbit maneuvering applications. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion systems, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy propellants. Technological advances developed in this program could improve the performance of expendable systems' payload capabilities by ~20 percent, and reduce launch, operations, and support costs by ~30 percent. Responsiveness and operability of propulsion systems will be enhanced for reusable launch systems. Technology advances could also lead to seven-year increase in satellite on-orbit time, a 50 percent increase in satellite maneuvering capability, a 25 percent reduction in orbit transfer operational costs, and a 15 percent increase in satellite payload. The efforts in this project contribute to the Integrated High Payoff Rocket Propulsion Technology program, a joint Department of Defense, National Aeronautics and Space Administration, and industry effort to focus rocket propulsion technology on national space launch needs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch vehicles.	12.482	13.892	0.000
(U) In FY 2005: Completed half of the number of tests in the Integrated Powerhead Demonstration test series. Scaled-up advanced lightweight thrust chamber and nozzle technologies. Completed initial scale-up of advanced cryogenic upper stage technologies including higher efficiency energy conversion systems.			
(U) In FY 2006: Continue scale-up and begin testing of advanced lightweight thrust chamber and nozzle technologies. Continue scale-up of advanced cryogenic upper stage technologies including higher efficiency energy conversion systems.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop solar electric propulsion technologies for existing and future satellites, upper stages, orbit transfer vehicles, and satellite formation flying, station keeping, and repositioning.	2.010	3.738	0.000
(U) In FY 2005: Completed initial development of electric propulsion systems for orbit-transfer by developing			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5033 Rocket Propulsion Demonstration

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	high-power Hall thrusters capable of LEO to geosynchronous earth orbit (GEO) transfer. Completed component fabrication for integration of a high-power Hall thruster demonstration. Completed delivery of the advanced small satellite propulsion demonstration unit for a microsatellite demonstration.			
(U)	In FY 2006: Continue development of electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of LEO to GEO transfer. Continue component development for the high-power Hall thruster demonstration. Support test flight of the advanced small satellite propulsion demonstration unit for a microsatellite demonstration.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop missile propulsion, aging, and surveillance technology for intercontinental ballistic missiles to include demonstration of missile propulsion technology and Post Boost Control Systems (PBCS). Note: Efforts complete in FY 2006.	3.861	6.521	0.000
(U)	In FY 2005: Completed fabrication of components for the PBCS demonstration and conducted test. Completed fabrication and initiated integration and test for the interim strategic sustainment demonstration motors. Commenced assessment and fabrication of the final strategic sustainment demonstration motors.			
(U)	In FY 2006: Complete fabrication of final components for the final strategic sustainment demonstration motors and prepare for test. Complete assessment and fabrication of the final strategic sustainment demonstration motors.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop electric and advanced chemical based monopropellant propulsion technologies for future satellite propulsion systems. Phases are referring to IHPRPT program phases.	0.614	0.835	0.000
(U)	In FY 2005: Completed demonstration of pulsed plasma thruster. Furthered the development of advanced Phase II monopropellant and vehicle propulsion ground demonstration.			
(U)	In FY 2006: Complete advanced monopropellant thruster demonstration.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Streaker - Small Launch Vehicle.	2.901	0.000	0.000
(U)	In FY 2005: Developed core boosters and payload interfaces for possible use in the small launch vehicle to be used for rapid and affordable deployment of small satellite payloads.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5033 Rocket Propulsion Demonstration

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	CONGRESSIONAL ADD: Vortex Cold Wall Low Cost Rocket Engines.	3.190	0.000	0.000
(U)	In FY 2005: Matured technologies for an advanced low-cost, low-weight, high-performance hydrocarbon vortex thrust chamber to integrate and test in flight-type engines.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Upper Stage Engine Technology (USET).	0.000	0.986	0.000
(U)	In FY 2005: Congress added $4.0 million for Upper Stage Engine Technology in PE 0602500F, Multi-Disciplinary Space Technology, Project 5026, Rocket Propulsion Component Technology.			
(U)	In FY 2006: Provide additional turbo-pump cavitation modeling, simulation, and tool development for use in future liquid rocket booster and upper stage engine designs and analysis.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	25.058	25.972	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602102F, Materials.									
(U) PE 0602203F, Aerospace Propulsion.									
(U) PE 0602601F, Spacecraft Technology.									
(U) PE 0603114N, Power Projection Advanced Technology.									
(U) PE 0603216F, Aerospace Propulsion Power Technology.									
(U) PE 0603401F, Advanced Spacecraft Technology.									
(U) PE 0603853F, Evolved Expendable Launch Vehicle Program.									
(U) This project has been									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5033 Rocket Propulsion Demonstration

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

coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE: 5034 Advanced Space Sensors

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5034 Advanced Space Sensors	7.159	7.116	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0603203F, Advanced Aerospace Sensors, Project 6388SP, Advanced Space Sensors, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates space sensor technologies, including radio frequency sensors; intelligence, surveillance, and reconnaissance sensors (ISR); electro-optical sensors; laser warning sensors; targeting and attack radar sensors; and electronic counter-countermeasures (ECCM) and communications. By developing multi-function radar, laser, electronic combat, and ECCM technologies for space applications, this project provides space platforms with the capability to precisely detect, track, and target air- and ground-based, high-value, time-critical targets, while remaining invulnerable to hostile and natural threats.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop a material signature analysis capability to evaluate the physical/chemical origins of paint/camouflage thermal reflectance features, and develop a forward predictive capability validated with empirical measurements. Note: Efforts complete in FY 2005	0.193	0.000	0.000
(U) In FY 2005: Completed the development of material signature analysis research into the area of polarimetric signatures. Developed an enhanced system-level modeling capability that incorporates additional signature modalities, including the addition of polarimetric signatures.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate technologies to maximize Global Positioning System (GPS) jam resistance, positional accuracy, timing accuracy, and exploitation techniques to improve offensive and defensive combat capabilities.	2.341	2.202	0.000
(U) In FY 2005: Demonstrated assured reference technologies to provide precise time, position, and velocity for on-board and off-board platform applications. Demonstrated antenna wavefront simulation technology to assess anti-jam GPS III techniques.			
(U) In FY 2006: Design space-based distributed position, navigation, and time (PNT) technologies to achieve optimal sensor fusion for a Common Operation Picture (COP). Design multi-ship virtual flight test simulation technology to assess networked clusters of mini" unmanned aerial vehicles.			
(U) In FY 2007: Not Applicable.			
(U)			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5034 Advanced Space Sensors

(U)	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST: Develop space laser warning sensor technologies for timely alert to advanced laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser-guided ordnance) signals.	1.101	1.630	0.000
(U)	In FY 2005: Initiated characterization of space-qualified false-alarm sensor modules. Fabricated and integrated space-qualified components for false-alarm sensor space flight engineering test units. Developed mechanical, electrical, and functional interfaces to a host satellite. Planned for on-orbit testing, data collection, and system evaluation. Downselected designs for space-qualified laser warning sensors for rapid detection and characterization of laser designators, trackers, dazzlers, and weapons.			
(U)	In FY 2006: Integrate false alarm package space-flight components onto space flight host. Continue planning and coordinating for on-orbit testing, data collection, and system evaluation. Develop risk-reduction technology for space-qualified laser warning sensors for rapid detection and characterization of laser designators, trackers, dazzlers, and weapons. Complete development of a space-based laser threat scenario testbed for satellite-as-a-sensor technology evaluations.			
(U)	In FY 2007: Not Applicable.			
(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).	3.524	2.957	0.000
(U)	In FY 2005: Developed 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. Developed subsystem technologies for a shared radio frequency/electro-optical aperture to service high bandwidth communication needs. Examined applicability of shared apertures to multiple user access capability. Developed aircraft optical network 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 2006: Continue development of an integrated electro-optical communication terminal for evaluation and testing of AISR links between an airborne communication testbed and ground terminals. Continue development of shared radio frequency/electro-optical apertures to service high bandwidth communication needs. Test applicability of shared apertures to maintaining air network link connectivity under in weather conditions. Install aircraft optical network 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. Demonstrate a combined radio frequency/ optical communication air to air to ground high bandwidth network.			
(U)	In FY 2007: Not Applicable.			
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5034 Advanced Space Sensors

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop, demonstrate, and evaluate spectral-temporal sensing technologies for detection and identification of transient and moving targets for battlespace surveillance and space situational awareness. Note: In FY 2006, spectral sensing technology efforts from PE 0603203F, Advanced Aerospace Sensors, are extended to the space environment.	0.000	0.327	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Design a testbed sensor to evaluate the performance potential of spectral-temporal sensing for battlespace surveillance missions. Model expected performance for a variety of targets, including muzzle flashes, artillery and tank fire, and battlefield explosions			
(U) In FY 2007: Not Applicable.			
(U)			
(U) Total Cost	7.159	7.116	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603203F, Advanced Aerospace Sensors.									
(U) PE 0603270F, Electronic Combat Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

PE NUMBER: 0603601F
PE TITLE: Conventional Weapons Technology

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	24.680	30.519	19.658	19.993	21.504	21.876	22.037	Continuing	TBD
670A	Conventional Weapons Development	12.436	30.519	19.658	19.993	21.504	21.876	22.037	Continuing	TBD
670B	Guidance Technology	12.244	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2006, the efforts covered under Project 670B were moved to Project 670A.

(U) A. Mission Description and Budget Item Justification

This program develops, demonstrates, and integrates ordnance and advanced guidance technologies for air-launched conventional weapons. The program includes development of conventional ordnance technologies including warheads, fuzes, and explosives; and development of advanced guidance technologies including seekers, navigation and control, and guidance. Note: In FY 2006, Congress added $1.3 million for Air Force Special Operations (AF/SO) Miniature Infrared Camera, $1.7 million for Body Armor and Fragmentation Protection, $1.7 million for Clandestine Electric Reconnaissance Vehicle, $1.0 million for Fuze Air-to-Surface Technlogy, $2.9 million for High Speed Strike Weapon, $1.0 million for Internet Protocol (IP) Targeting Extension System, $1.7 million for Micro-Sized Air Launched Atmospheric Visibility Sonde, and $1.0 million for Plug and Play Capability for Air-Launched Munitions. This program is in the 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) B. Program Change Summary ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	27.255	18.660	19.094
(U)	Current PBR/President's Budget	24.680	30.519	19.658
(U)	Total Adjustments	-2.575	11.859	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.021	-0.441	
	Congressional Increases		12.300	
	Reprogrammings	-2.034		
	SBIR/STTR Transfer	-0.520		
(U)	Significant Program Changes:			

Not Applicable.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology	PROJECT NUMBER AND TITLE: 670A Conventional Weapons Development	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
670A	Conventional Weapons Development	12.436	30.519	19.658	19.993	21.504	21.876	22.037	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops, demonstrates, and integrates ordnance and affordable, autonomous, and adverse weather resistant guidance technologies for enhancing the effectiveness of air-launched conventional weapons delivered from manned and unmanned aerospace vehicles. The project develops conventional ordnance including warheads, fuzes, explosives, carriage and release, munition integration technologies, terminal seekers, midcourse navigation sensors for stand off delivery weapons, and target detection and identification processing algorithms for reducing target location error to improve target kill probability. This project improves the capability for conventional munitions supporting an Air Expeditionary Force.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate advanced air-delivered munitions fuze and mass-focusing warhead technologies to improve munition effectiveness, allowing for smaller warheads and munition airframes, thereby improving sortie effectiveness and increasing strike aircraft load-outs. Develop a fuzing capability that will transmit function data from penetrating weapons through various hard target mediums. Note: In FY 2007, funding will be reduced as fuze efforts go to a single demonstration.	3.436	3.789	3.768
(U) In FY 2005: Designed a fuze using Microwave Monolithic Integrated Circuit technologies that will give burst accuracy of 0.5 meter for weapons that have closure rates up to 2,500 meters per second. Conducted research studies for designing a hard target influence fuze capable of denying hard and deeply buried facilities access.			
(U) In FY 2006: Continue designing a hard target influence fuze capable of denying hard and deeply buried facilities access. Begin developing fuzes that can transmit bomb damage information to an aircraft platform.			
(U) In FY 2007: Continue designing a hard target influence fuze capable of denying hard and deeply buried facilities access. Complete developing fuzes that can transmit bomb damage information to an aircraft platform.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate conventional munition subsystem and platform integration technologies to include innovative air-delivered munition carriage and release equipment, miniature weapon release concepts, and reduced airframe size providing the capability to safely carry, launch, and communicate with the aerospace vehicle and other multiple miniature weapons. These integration technologies will increase weapon load-outs and improve sortie effectiveness for current and future strike aircraft, while reducing munition airlift requirements.	1.202	1.875	0.241
(U) In FY 2005: Conducted analysis studies on a weapon that can neutralize hardened chemical and biological warfare facilities. Completed an initial effort to develop a multi-mode ordnance package effective against a broad range of			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology	PROJECT NUMBER AND TITLE 670A Conventional Weapons Development

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	unhardened ground targets.			
(U)	In FY 2006: Integrate a miniaturized datalink into a weapon system to perform retargeting in-flight. Begin planning a datalink flight demonstration. Begin planning a low-cost miniature cruise missile demonstration. Begin planning a miniature persistent munition demonstration that will provide area dominance with a multiple-shot capability.			
(U)	In FY 2007: Complete planning a miniaturized datalink flight demonstration. Enhance plans and begin design of a low-cost miniature cruise missile. Mature plans and begin design of a miniature persistent munition that will provide area dominance with a multiple-shot capability. Note: Datalink flight test will be conducted in the navigation and control technologies activity in this project.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate advanced conventional armament warhead technologies, including heavy metal liners, dense metal cases, and insensitive explosives with increased energy release performance attributes. The goal of these efforts is to destroy hardened targets by more effectively penetrating protective surfaces and by enhancing kill mechanisms against softer surface targets.	2.843	6.982	6.751
(U)	In FY 2005: Tested on high speed sled track a weapon capable of high-speed penetration of extremely hard targets by integrating new warhead case technology, insensitive explosive, and a multiple-event fuze. Improved insensitive explosive warhead fills thru analysis and testing with an end goal to significantly reduce the fill volume completing the intended ordnance mission.			
(U)	In FY 2006: Continue to improve insensitive explosive warhead fills with a goal to significantly reduce the fill volume completing the intended ordnance mission. Commence developing an ordnance package that will significantly improve counter-air lethality against cruise missiles and manned aircraft. Initiate design of a multi-mode warhead package designed for precision-guided submunitions. Begin developing a weapon system capable of dispensing payloads within a target for counterforce applications.			
(U)	In FY 2007: Complete insensitive explosive warhead fills that significantly reduce fill volume requirements. Continue developing an ordnance package that will significantly improve counter air lethality against cruise missiles and manned aircraft. Continue developing a multi-mode warhead package designed for precision-guided submunitions. Continue developing a weapon system capable of dispensing payloads within a target for counterforce applications.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate advanced conventional armament seeker technologies for miniature munitions applications. These seeker technologies will autonomously detect, acquire, and guide to targets of interest in adverse weather and battlefield conditions. Also, the seeker technologies will increase the probability of kill and minimize collateral damage, while providing increased weapons load-out and improved sortie effectiveness. Note:	0.000	0.000	7.839

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603601F Conventional Weapons Technology**	PROJECT NUMBER AND TITLE **670A Conventional Weapons Development**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Prior to FY 2006, these efforts were covered under Project 670B in this Program Element. In FY 2007, the Miniature Navigator Demonstration (in another thrust in this project) will be completed allowing seekers for two different munition concepts to be initiated.			
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Continue design and fabrication of low-cost laser detection and ranging seeker that will increase data rate and reduce moving parts compared to earlier generation laser seeker technologies. Initiate planning for a small, multiple-mode radar demonstration for air-to-surface weapon applications.			
(U)	In FY 2007: Continue design and fabrication, and commence ground and flight test a low-cost laser detection and ranging seeker that reduces moving parts compared to earlier generation seekers. Mature plans and begin designing a small multiple-mode radar for an air to surface weapon demonstration.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate advanced conventional armament navigation and control technologies to increase armament navigation accuracy, improve stand off range, and enhance weapons control and operation in electronic jamming environments. Note: Prior to FY 2006, these efforts were covered under Project 670B in this Program Element. In FY 2007, the Miniature Navigator Demonstration will be completed allowing seekers for two different munition concepts to be initiated (in another thrust in this project).	0.000	5.748	1.059
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Finish developing and demonstrate a munition navigation system that provides accurate (less than a meter), miniature (less than 25 cubic inch), and affordable (less than $6000 per unit) global positioning management system. Develop a capability for weapons to datalink information to a communications grid.			
(U)	In FY 2007: Complete design and fabrication of a weapon datalink and integrate datalink into a guided munition for commencement of flight testing.			
(U)				
(U)	CONGRESSIONAL ADD: High Speed Strike Weapon.	0.971	2.858	0.000
(U)	In FY 2005: Conducted preliminary design study of a high-speed weapon to provide a quick strike capability against time-critical targets.			
(U)	In FY 2006: Refine the design and development high-speed flight test vehicle for a quick strike capability for time-critical targets			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: BLU-109 Bunker Buster - Heavy.	2.915	0.000	0.000
(U)	In FY 2005: Improved penetration performance on BLU-109 (with a tungsten metal ballast in the warhead and a			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology	PROJECT NUMBER AND TITLE 670A Conventional Weapons Development

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	Joint Direct Attack Munition (JDAM) tailkit) seeking performance similar to BLU-113.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Fuze Air-to-Surface Technology (FAST).	1.069	0.986	0.000
(U)	In FY 2005: Developed and demonstrated, in breadboard fashion, a cost-effective integrated height-of-burst fuze, Global Position Satellite/Inertial Navigation System (GPS/INS) altitude error correction, and in-flight retargeting receiver capability for precision air delivered munitions.			
(U)	In FY 2006: Perform trade studies to validate FAST flexible manufacturing approach for low-cost, high performance radars.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Air Force Special Operations (SO) and Miniature Infrared Camera.	0.000	1.281	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop a miniature infrared camera top be used on small unmanned vehicles.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Body Armor and Fragmentation Protection.	0.000	1.676	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop armor systems to protect the upper body of a vehicle inhabitant against fragmentation as rifle threats. Systems will also be developed and improved to protect lower extremities of vehicle inhabitants from Improvised Explosive Devices (IEDs).			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Clandestine Electric Reconnaissance Vehicle.	0.000	1.676	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: The Clandestine Electric Reconnaissance Vehicle (CERV) program will adapt world-class racing technology for tactical military applications. The CERV program will build two 1,200 pound, electric demonstration vehicles.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Internet Protocol (IP) Targeting Extension System.	0.000	0.986	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology	PROJECT NUMBER AND TITLE 670A Conventional Weapons Development

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Development and implementation of the prototype IP-based weapons data link system that includes a handheld wireless IP-based device such as Air Force Special Operations Command Special Operations Forces Tactical Network (SOFTNET) system.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Micro-Sized Air-Launched Atmospheric Sonde.	0.000	1.676	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop a small Sonde that senses atmospheric visibility and weather data during descent as well as reporting on other deployed remote sensors with seismic and acoustic data.			
(U)	FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Plug and Play Capability for Air-Launched Weapons.	0.000	0.986	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Develop and demonstrate the integration of Universal Armament Interface (UAI) weapon or UAI weapn emulator within a service-based architect that is compatible with netweork centric operations.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	12.436	30.519	19.658

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602602F, Conventional Munitions.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology	PROJECT NUMBER AND TITLE: 670B Guidance Technology	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
670B Guidance Technology	12.244	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: After FY 2005, these efforts will be covered under Project 670A in this Program Element.

(U) A. Mission Description and Budget Item Justification

This project develops, demonstrates, and integrates affordable, autonomous, and adverse weather advanced guidance technologies for conventional armaments delivered from manned and unmanned aerospace vehicles. This project includes development of conventional weapon guidance systems including terminal seekers, midcourse navigation sensors for stand off delivery weapons, and target detection and identification processing algorithms for reducing target location error to improve target kill probability.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate advanced conventional armament seeker technologies for miniature munitions applications. These seeker technologies will autonomously detect, acquire, and guide to targets of interest in adverse weather and battlefield conditions. Also, the seeker technologies will increase the probability of kill and minimize collateral damage, while providing increased weapons load-out and improved sortie effectiveness. Note: In FY 2006, these efforts will be moved to Project 670A in this Program Element.	0.824	0.000	0.000
(U) In FY 2005: Conducted preliminary design and fabrication of a low-cost, laser detection and ranging seeker to increase data rate and reduce moving parts of earlier generation laser seeker technologies.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate advanced conventional armament navigation and control technologies to increase armament navigation accuracy, improve stand off range, and enhance weapons control and operation in electronic jamming environments. Note: In FY 2006, these efforts will be moved to Project 670A in this Program Element.	3.324	0.000	0.000
(U) In FY 2005: Conducted test and analysis to support the development a munitions navigation system using micro-electromechanical system technology to provide an accurate (less than one meter), miniature (less than 25 cubic inches), and affordable (less than $6,000 per unit) Global Positioning System/Inertial Measurement Unit navigation system.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603601F Conventional Weapons Technology**	PROJECT NUMBER AND TITLE **670B Guidance Technology**

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Integrate advanced conventional guidance technologies including seekers, processors, controls, datalinks, and algorithms to provide improved adverse weather performance, faster processing of target information, higher probability of target detection, an operationally acceptable target false alarm rate, and enhance the effectiveness of miniature munitions against both mobile and fixed ground targets. Note: In FY 2006, this effort will be completed. Further guidance integration efforts will be executed under Project 670A in this Program Element.	8.096	0.000	0.000
(U) In FY 2005: Developed and tested Low-Cost Autonomous Attack System (LOCAAS) datalink for flight test that will provide the capability to re-target in-flight after munition has separated from launch aircraft.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	12.244	0.000	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602602F, Conventional Munitions									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

PE NUMBER: 0603605F
PE TITLE: Advanced Weapons Technology

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	49.782	49.821	51.336	51.057	53.351	60.190	61.282	Continuing	TBD
11SP	Advanced Optics and Laser Space Tech	0.000	0.000	21.410	22.516	22.391	28.620	29.152	0.000	0.000
3150	Advanced Optics Technology	17.250	10.449	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
3151	High Power Solid State Laser Technology	17.419	21.997	15.055	15.296	16.594	16.935	17.248	Continuing	TBD
3152	High Power Microwave Technology	7.904	10.526	12.941	11.285	12.252	12.505	12.738	Continuing	TBD
3647	High Energy Laser Technology	7.209	6.849	1.930	1.960	2.114	2.130	2.144	Continuing	TBD

Note: Funds for the FY 2006 Congressionally-directed Aerospace Relay Mirror System in the amount of $2.100 million are in the process of being moved to PE 0603605F, Advanced Weapons Technology, from PE 0603500F, Multi-Disciplinary Advanced Development, for execution.

(U) A. Mission Description and Budget Item Justification

This program provides for the development and demonstration of advanced directed energy and optical concepts that are not space unique. In solid state lasers, compact, reliable, relatively high power, cost-effective single electric laser devices and arrays of electric laser devices are demonstrated. In high power microwaves, technologies such as narrowband and wideband devices and antennas are demonstrated. In high energy lasers, technologies such as high power chemical lasers and beam control technologies are demonstrated. Note: In FY 2006, Congress added $1.1 million for the Satellite Active Imaging National Testbed Program, $6.0 million for Applications of LIDAR to Vehicles with Analysis (ALVA), $3.4 million for the Low Speed Airspeed System, $1.8 million for the Near Earth Space Surveillance Initiative, $3.0 million for the Wafer Integrated Semiconductor Laser, $1.7 million for Mobile Active Targeting Resource for Integrated Experiments, $5.1 million Laser Spark Countermeasure Program, and $2.5 million for High Brightness Laser Diode for Fiber Laser Pumps. 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.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	56.877	26.955	29.542
(U)	Current PBR/President's Budget	49.782	49.821	51.336
(U)	Total Adjustments	-7.095	22.866	
(U)	Congressional Program Reductions		-0.014	
	Congressional Rescissions	-0.048	-0.720	
	Congressional Increases		23.600	
	Reprogrammings	-5.818		
	SBIR/STTR Transfer	-1.229		

(U) Significant Program Changes:

In FY 2007, Project 11SP, Advanced Optics and Laser Space Technology, efforts will transfer from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5031, Advanced Optics and Laser Space Technology, in order to more effectively manage and provide oversight of the efforts.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE: 11SP Advanced Optics and Laser Space Tech	

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
11SP	Advanced Optics and Laser Space Tech	0.000	0.000	21.410	22.516	22.391	28.620	29.152	0.000	0.000
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts will transfer from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5031, Advanced Optics and Laser Space Tech, to this project in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project provides for the demonstration and detailed assessment of space unique technologies needed for advanced optical systems and high-energy laser weapons.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate advanced, long-range relay mirror optical technologies such as advanced adaptive optics, beam control, large lightweight optics, optical coatings, throughput, dual line-of-sight control, spacecraft, and optical control integration, beam stabilization, and jitter control.	0.000	0.000	0.796
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Investigate a high power demonstration to kill ground/airborne targets through a relay mirror. Apply a dielectric coating on and test a high energy laser, meter-class, silicon carbide primary mirror. Complete the initial closed-loop performance of selected advanced wavefront control devices for imaging and beam control from space.			
(U)			
(U) MAJOR THRUST: Perform atmospheric compensation/beam control experiments for application including antisatellite weapons, relay mirror systems, satellite tests and diagnostics, and high-resolution satellite imaging.	0.000	0.000	5.713
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Demonstrate fully compensated laser propagation to low earth orbit satellites; measure beam profile and intensity on target. Begin development of precision aimpoint stabilization through turbulence.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate advanced optical beam control technologies for laser propagation through severe and/or extended atmospheric turbulence.	0.000	0.000	14.901
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Integrate advanced ground test system for characterization of laser propagation through atmospheric turbulence. Demonstrate and characterize operation of advanced adaptive optical and tracking technologies for laser			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 11SP Advanced Optics and Laser Space Tech

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	propagation to space targets in stressing atmospheric conditions.			
(U)	Total Cost	0.000	0.000	21.410

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

		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U)	PE 0602500F, Multi-Disciplinary Space Technology									
(U)	PE 0602605F, Directed Energy Technology									
(U)	PE 0603444F, Maui Space Surveillance System									
(U)	PE 0603605F, Advanced Weapons Technology									
(U)	PE 0603883C, Ballistic Missile Defense Boost Phase Segment									
(U)	This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE: 3150 Advanced Optics Technology	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3150 Advanced Optics Technology	17.250	10.449	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops advanced optical technologies for various strategic and tactical beam control applications.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) CONGRESSIONAL ADD: Applications of LIDAR to Vehicles with Analysis (ALVA).	7.753	5.915	0.000
(U) In FY 2005: Developed use of vibrometry for space situational awareness. Upgraded tracking ability by a factor of three using the Field Laser Demonstrator's Hi-Class laser radar for deep space metric and space object identification missions, microsatellite tracking, and ballistic missile defense discrimination. Demonstrated novel concepts that use laser radars to increase information gathering capability. Demonstrated laser radars capability to provide a range of battlefield information such as battle damage assessment and camouflage penetration. Investigated eye-safe laser radars and showed increased battlefield information in combat identification, battle damage assessment, and camouflage penetration. Integrated an laser radar and sensors into an operational airborne turret ball for transition to the warfighter.			
(U) In FY 2006: Conduct Congressionally-directed effort for ALVA.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) CONGRESSIONAL ADD: Laser Illuminated Viewing and Ranging Sensor Development.	2.035	0.000	0.000
(U) In FY 2005: Developed full wafer eye-safe laser sensors and integrated and tested in field demonstrations to show applicability to Air Force programs for obtaining battlefield intelligence. Refined and improved the current airborne gated electron bombarded active pixel sensor and mate it with an advanced processing chip to form a laser-sensing imaging subsystem. Demonstrated the achieved weight and power improvement of this delivered sensor subsystem, followed by preliminary integration of the new sensor subsystem into an operational imaging system.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) CONGRESSIONAL ADD: Near Earth Space Surveillance Initiative.	2.714	1.774	0.000
(U) In FY 2005: Completed designs and initial fabrication of a second generation prime focus spectrograph. Formulated detailed designs and costs of the complete spectrograph. Completed improvements to the high resolution spectrograph of the Hobby-Eberly Telescope. Installed mirror coating facility and continuous cleaner to support			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 3150 Advanced Optics Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	fabrication efforts.			
(U)	In FY 2006: Conduct Congressionally-directed effort for the Near Earth Space Surveillance Initiative.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Satellite Active Imaging National Testbed Program. Note: In FY2005 this add was titled Geosynchronous Light Imaging National Testbed (GLINT).	4.748	1.084	0.000
(U)	In FY 2005: Completed partial ground field demonstration of the GLINT imaging technique to test optical components. Completed an analytical and simulation based assessment of the viability of using the GLINT imaging technique on low earth orbit satellites and compare estimated performance with other low earth orbit active imaging techniques. Developed, and/or modified, and tested optical transmitting and receiving components in the laboratory and in the field, traceable to a low earth orbit imaging system and a geosynchronous earth orbit system in the out years. Explored methods for enhanced characterization of space targets, including microsats, using advanced concepts for laser illumination and sensing.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Satellite Active Imaging National Testbed Program.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Mobile Active Targeting Resource for Integrated Experiments.	0.000	1.676	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Mobile Active Targeting Resource for Integrated Experiments.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	17.250	10.449	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0603444F, Maui Space Surveillance Systems.									
(U) PE 0602102F, Materials.									
(U) PE 0602605F, Directed Energy Technology.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603605F Advanced Weapons Technology**	PROJECT NUMBER AND TITLE **3150 Advanced Optics Technology**

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

(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.

(U) PE 0602500F, Multi-Disciplinary Space Technology.

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE: 3151 High Power Solid State Laser Technology

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3151	High Power Solid State Laser Technology	17.419	21.997	15.055	15.296	16.594	16.935	17.248	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project provides revolutionary breakthroughs in efficient, robust, and affordable solid state laser technologies for a wide range of military applications requiring small, high power laser sources. This includes slab, semiconductor, fiber, ceramic, disk, and ultra-short pulse lasers. This is a long-term technology development project with both near-term and long-term payoffs. Near-term goals include developing compact, reliable infrared sources that can be used for a range of applications including night vision systems, landing zone markers, remote sensing, and covert communication systems. Longer-term goals focus on producing compact, significantly higher power sources that could be applied to military weapons-type applications including aircraft self-protection. This project leads the development of, and builds upon, a wide range of commercial advancements. Commercially available solid state lasers are widely used due to their low-cost, small size and weight, high reliability, and high efficiency in converting electricity to laser energy. This project preserves these attractive features while continually scaling output to higher powers and efficiencies and to military application-specific wavelengths. This project is divided into two technology areas. The first area investigates methods to develop low-cost, scalable, high power solid state lasers. This effort builds upon a strong industrial technology base. The second area develops wavelength specific solid state lasers for military applications such as infrared countermeasures.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Demonstrate scalability of high-power electric laser architectures for tactical directed energy applications such as aerial vehicle target designators/imagers and next generation weapon components for applications such as advanced gunship weapons and long range airborne laser illuminators.	4.387	10.466	13.434

(U) In FY 2005: As part of the Joint High Power Solid State Laser program, demonstrated several kilowatts using a modular approach that has scalability to 100 kilowatts. Addressed systems-level issues such as weight, volume, power, and thermal management requirements between various approaches funded by the Army, Air Force, and High Energy Laser Joint Technology Office to determine the next step for the Air Force.

(U) In FY 2006: Benchmark technologies in an effort to obtain architectures that are favorable in terms of size, weight, efficiency, affordability, reliability, maintainability, supportability environmental acceptability (air, land and maritime), and ruggedness for tactical weapon applications. Begin development of an electric laser that is scalable to the weapons-class level.

(U) In FY 2007: Continue scaling solid state and electric lasers with a goal of reaching the weapons-class power, beam quality, run time, etc., levels. Focus on architectures that are favorable in terms of size, weight, efficiency, affordability, reliability, maintainability, supportability, operational environmental acceptability, and ruggedness for tactical weapon applications.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603605F Advanced Weapons Technology**	PROJECT NUMBER AND TITLE **3151 High Power Solid State Laser Technology**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	MAJOR THRUST: Develop and demonstrate solid state laser technologies for moderate power airborne tactical applications, focusing on aircraft self-defense with integrated detection and tracking of targets in clutter.	4.548	3.745	1.621
(U)	In FY 2005: Developed laser source and associated beam control to control platform vibration, atmospheric jitter, and aero-optic effects. Investigated technologies to detect and track tactical targets. Performed laser effects testing to determine required energy levels for tactical applications that address defeating next generation air-to-air threats. Designed and built a laser system capable of emitting multi-wavelengths. Designed laser source and tested hardware to evaluate ultra-short pulse laser technology.			
(U)	In FY 2006: Enhance laser sources to detect and track tactical targets. Begin development of a laser for eventual use on an airborne tactical platform to defeat next generation air-to-air threats. Demonstrate a beam director that has the capability of handling a sensor-killer laser, while retaining all of the functions of infrared countermeasures and search functions. Prepare lasers and their gimbal for a day-night electro-optical tracker countermeasures advanced technology demonstration.			
(U)	In FY 2007: Complete development of a laser for eventual use on an airborne tactical platform. Investigate integrating the laser technology with tactical platform sub-systems such as power, advanced thermal management systems, avionics, sensors, and fire control to increase the potential for successful transition. Continue tactical laser applications. Prove tactical laser utility through field demonstrations and customer interaction.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate laser source technologies needed to counter current air-to-air and surface-to-air missile threats.	0.059	0.000	0.000
(U)	In FY 2005: Finalized laser source technology for transition to warfighters.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Low Speed Airspeed System. Note: In FY 2005, this Add was titled Low Speed Air Data Sensor for Special Operations Aircraft.	3.370	3.351	0.000
(U)	In FY 2005: Developed mature technology, which will provide fiber optic laser-based rotorcraft airspeed data. This advanced technology will increase the operational safety of fixed wing and rotary aircraft during hovering maneuvers and landing.			
(U)	In FY 2006: Conduct Congressionally-directed effort for a Low Speed Airspeed System.			
(U)	In FY 2007: Not Applicable.			
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 3151 High Power Solid State Laser Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	CONGRESSIONAL ADD: Advanced Technology for Infrared Countermeasures Component Improvement.	2.081	0.000	0.000
(U)	In FY 2005: Matured mid-infrared semiconductor laser for infrared countermeasures applications with demonstration of laser performance in operational military environments. Conducted testing with the pointer/tracker to validate integration with infrared countermeasures system. Conducted reliability engineering and component testing to quantify the reliability and lifetime of the technology.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Wafer Integrated Semiconductor Laser.	2.974	1.971	0.000
(U)	In FY 2005: Developed novel surface emitting structures for semiconductor laser arrays. Refined the basic technology developed in the previous year using 45-degree turning mirrors by testing and improving reliability, and improving yield to reduce overall cost. Etched integrated fast-axis collimation lenses into the semiconductor material. Explored other technologies for producing surface emitting semiconductor laser arrays.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Wafer Integrated Semiconductor Lasers.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: High Brightness Laser Diode Source for Fiber Laser Pumps.	0.000	2.464	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for High Brightness Laser Diode Source for Fiber Laser Pumps.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	17.419	21.997	15.055

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:
(U) PE 0602102F, Materials.
(U) PE 0603270F, Electronic Combat Technology.
(U) PE 0602605F, Directed Energy Technology.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603605F Advanced Weapons Technology**	PROJECT NUMBER AND TITLE **3151 High Power Solid State Laser Technology**

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

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT NUMBER AND TITLE: 3152 High Power Microwave Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3152 High Power Microwave Technology	7.904	10.526	12.941	11.285	12.252	12.505	12.738	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops high power microwave (HPM) generation and transmission technologies that support a wide range of Air Force missions such as the potential disruption, degradation, damage, or destruction of an adversary's electronic infrastructure and military capability. These targeted capabilities include local computer and communication systems, as well as large and small air defense and command and control systems. In many cases, this effect can be generated covertly with no collateral structural or human damage. In addition, millimeter wave force protection technologies are developed. It also develops a susceptibility, vulnerability, and lethality data base to identify potential vulnerabilities of U.S. systems to HPM threats and to provide a basis for future offensive and defensive weapon system decisions. Representative U.S. and foreign assets are tested to understand real system susceptibilities. Both wideband (wide frequency range) and narrowband (very small frequency range) technologies are being developed.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate HPM technologies to disrupt, degrade, damage, or destroy an adversary's electronic systems.	0.916	1.236	1.366
(U) In FY 2005: Demonstrated pulsed power and narrowband HPM source capability applicable to munitions and airborne concepts. Demonstrated a repetitively pulsed multi-gigawatt-class HPM integration experiment. Demonstrated brassboard short-range wideband hidden weapon identification concept.			
(U) In FY 2006: Integrate a repetitively pulsed gigawatt-class HPM source and antenna that will be installed into an airborne platform. Conduct integration experiments that include investigating electromagnetic interference issues. Examine the interactions of the HPM source, antenna, and pulse power to increase functionality. Demonstrate short-range wideband hidden weapon identification in a real world environment.			
(U) In FY 2007: Demonstrate the performance of the integrated repetitively pulsed gigawatt-class HPM source and antenna system. Investigate HPM system interaction with the flight controls of the airborne platform. Perform system diagnostics on integrated experiment to ensure proper source operation.			
(U)			
(U) MAJOR THRUST: Conduct effects experimentation to expand and refine data library and support susceptibility predictions. Investigate and develop technologies for development of an HPM airfield defense system.	0.537	0.727	0.759
(U) In FY 2005: Provided dynamic data library to users and continue effects experimentation to populate and update the data library. Transitioned computer codes for the prediction of electromagnetic coupling on targets to users. Expanded the evaluation and quantification of HPM waveform effectiveness against new and evolving electronic targets of interest. Transitioned computer codes for calculation of probability-of-kill for representative targets.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603605F Advanced Weapons Technology**	PROJECT NUMBER AND TITLE **3152 High Power Microwave Technology**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2006: Transition HPM engagement lethality modeling and simulation capability into Air Force Standard Analysis Toolkit and to additional users. Executed high power microwave effects tests to improve HPM system design and lethality. Identified and mitigated vulnerabilities of U.S. infrastructure to HPM attack.			
(U)	In FY 2007: Model real targets and predict probability of kill for various HPM scenarios, including HPM/radio-frequency airfield defense against small surface to air missile attack. Identify and mitigate additional vulnerabilities of United States infrastructure to HPM attack. Continue high power microwave effects tests to improve HPM system design and lethality. Investigate electromagnetic interference/electromagnetic compatibility sub-system and system interface issues.			
(U)				
(U)	MAJOR THRUST: Develop and evaluate active denial technologies for non-lethal, anti-personnel weapon applications such as ground force protection from a stand off aircraft.	3.191	4.290	6.138
(U)	In FY 2005: Provided user support operation/testing/demonstration of first ground-based development spiral product. Developed and evaluated technologies for non-lethal weapons applications. Developed millimeter wave source for airborne applications. Baselined computational physics simulations of millimeter-wave sources against the draft detailed design drawings. Investigated updated subsystem approaches based on the original airborne technical feasibility study. Provided technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and glean data relevant to airborne applications.			
(U)	In FY 2006: Complete support of user operation/testing/demonstration of first ground-based development spiral product. Develop and evaluate technologies for non-lethal weapons applications. Continue the development of millimeter wave source for airborne applications. Complete computational physics simulations of millimeter-wave sources against the draft detailed design drawings for the coaxial source approach. Perform cold testing for conventional source hardware followed by progression towards final source assembly. Provide technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and glean data relevant to airborne applications.			
(U)	In FY 2007: Develop and evaluate technologies for non-lethal weapons applications. Continue the development of millimeter wave source for airborne applications. Perform manufacturer test of first phase conventional source approach. Identify deficiencies and begin rebuild. Complete critical design review for coaxial source design. Investigate updated subsystem approaches based on the original airborne technical feasibility study. Begin hardware development for full power source test stand including award of test stand contract. Provide technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and glean data relevant to airborne applications.			
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 3152 High Power Microwave Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST: Develop the technology to integrate HPM devices on aerial platforms and investigate specific target sets of interest. Develop and demonstrate HPM technologies to disrupt, degrade, damage, or destroy an adversary's electronic systems.	3.260	4.273	4.678
(U)	In FY 2005: Proceeded with target identification efforts to include foreign and domestic and individual and cluster targets. Performed target lethality assessments. Maintained and upgraded the test facilities. Investigated source to aircraft integration issues such as electrical and physical interface, thermal control, center of mass, antennas, and electromagnetic interference/electromagnetic compatibility. Tested determined source shielding requirements for mounting a source on an aircraft. Investigated the feasibility of using ultra-wideband HPM to geolocate and identify targets of interest and perform battle damage assessment.			
(U)	In FY 2006: Proceed with maturation and miniaturization of HPM subsystem technologies, and begin their integration. Begin integration of all HPM subsystem components in preparation for stand-alone field demonstration. Refine HPM subsystem to ensure required energy levels are produced. Integrate the HPM subsystem with the command and control device to demonstrate operation at threshold operating parameters. Begin hardening of chosen platform against HPM subsystem predicted electromagnetic interference/coupling. Continue integration and test activities to determine the least risky path forward to transitioning technologies for an HPM Airborne Electronic Attack system.			
(U)	In FY 2007: Continue miniaturization, integration and ruggedization of HPM system for field experimentation. Examine the interactions of the HPM source, antenna, and pulse power to increase functionality. Investigate optimal configuration for permanent magnets in relativistic magnetron, and fabricate source. Begin fabrication of subcomponents as determined by FY 2006 risk reduction exercise. Complete integration and begin HPM system testing and diagnostics on hardware developed and integrated in FY 2006 for efficiency and to determine any potential electromagnetic interference/coupling issues. Improve HPM system command and control systems for pulsed operation greater than threshold levels.			
(U)	Total Cost	7.904	10.526	12.941

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602202F, Human Systems Technology.									
(U) PE 0602605F, Directed Energy									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603605F Advanced Weapons Technology**	PROJECT NUMBER AND TITLE **3152 High Power Microwave Technology**

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

Technology.

(U) PE 0603851M, Nonlethal Weapons - Demonstration/Validation.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE: 3647 High Energy Laser Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3647 High Energy Laser Technology	7.209	6.849	1.930	1.960	2.114	2.130	2.144	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the FY 2006 Congressionally-directed Aerospace Relay Mirror System in the amount of $2.100 million are in the process of being moved to PE 0603605F, Advanced Weapons Technology, from PE 0603500F, Multi-Disciplinary Advanced Development, for execution.

(U) A. Mission Description and Budget Item Justification

This project provides for the development, demonstration, and detailed assessment of non-space unique technologies needed for high energy laser weapons. Near-term focus is on airborne high energy laser missions, although the technology developed for this project is directly applicable to most high energy laser applications. Critical technologies developed and demonstrated include advanced high energy laser devices and laser beam control to efficiently compensate and propagate laser radiation through the atmosphere to a target. Correcting the laser beam for distortions induced by propagation through the turbulent atmosphere is the key technology in most long-range high energy laser applications. Detailed computational models to establish high energy laser weapon effectiveness and target vulnerability are developed.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate the technology for scalable, high energy laser devices with improved efficiency for insertion in tactical airborne lasers and other potential weapon applications.	4.087	1.822	1.930
(U) In FY 2005: Conducted follow-on demonstrations of advanced iodine generation, iodine injection, and chemical oxygen iodine test sequence utilizing the laboratory test stand. Integrated the best iodine generation concept into a laser device to predict overall device-level performance and identify device-level issues. Performed laboratory demonstrations of closed-cycle chemical approaches for use on tactical airborne platforms.			
(U) In FY 2006: Identify overall device-level performance and issues based on the integration of the iodine generation and ejector nozzle concept into a laser device. Perform field demonstrations of closed-cycle chemical approaches for use on tactical airborne platforms. Use deuterated chemicals to improve device performance. Begin work to extend the range of high power airborne chemical lasers.			
(U) In FY 2007: Continue working with new, advanced subsystems and technological concepts for future use on tactical and strategic platforms. Provide technical expertise and background to external organizations tailoring high energy laser concepts and capabilities to their needs. Demonstrate high-performance oxygen generator concepts for airborne laser applications. Evaluate iodine injection schemes for oxygen generators.			
(U)			
(U) MAJOR THRUST: Develop and evaluate beam control and compensation techniques including correcting for atmospheric attenuation and distortion of high energy laser beams propagating from airborne platforms.	3.122	0.000	0.000
(U) In FY 2005: Completed beam control technology demonstration and transition of these technologies to the Airborne Laser (ABL) System program. Completed concept evaluations using the ABL wave optics code that includes more			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 3647 High Energy Laser Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	detailed models of the Airborne Laser beam control system. Completed field testing of advanced tracking algorithms and adaptive optics techniques at the North Oscura Peak propagation range. Matured advanced beam control technologies. Fabricated and tested low absorption deformable mirror coating and compared to existing deformable mirror coating.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Laser Spark Countermeasure Program.	0.000	5.027	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for the Laser Spark Countermeasure Program.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	7.209	6.849	1.930

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602605F, Directed Energy Technology.									
(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									
(U) The technology efforts in this PE									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603605F Advanced Weapons Technology**	PROJECT NUMBER AND TITLE **3647 High Energy Laser Technology**

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

that are supporting future enhancements to airborne lasers have been coordinated with the Airborne Laser program office.

(U) D. Acquisition Strategy

Not Applicable.

PE NUMBER: 0603723F
PE TITLE: Environmental Engineering Technology

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603723F Environmental Engineering Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	0.000	1.873	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
2103 Environmental Quality Technology	0.000	1.873	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2000, the Air Force terminated this program. However, Congress has added funds for Congressionally-directed efforts since FY 2000. Funds for the FY 2006 Congressionally-directed Massively Parallel Optical Interconnects (MPOI) for Battlespace Information Exchange in the amount of $1.9 million are in the process of being moved to PE 0603789F, C3I Advanced Development, from PE 0603723F, Environmental Engineering Technology, for execution.

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates advanced technologies to address Air Force-unique environmental compliance, site remediation, and pollution prevention problems. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates advanced technologies to address Air Force environmental problems.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	0.000	0.000	0.000
(U)	Current PBR/President's Budget	0.000	1.873	0.000
(U)	Total Adjustments	0.000	1.873	
(U)	Congressional Program Reductions			
	Congressional Rescissions		-0.027	
	Congressional Increases		1.900	
	Reprogrammings			
	SBIR/STTR Transfer			

(U) Significant Program Changes:

In FY 2000, the Air Force terminated this program. However, Congress has added funds for Congressionally-directed efforts since FY 2000.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	0603723F Environmental Engineering Technology	2103 Environmental Quality Technology

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2103 Environmental Quality Technology	0.000	1.873	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2000, the Air Force terminated this program. However, Congress has added funds for Congressionally-directed efforts since FY 2000.

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates advanced technologies to address Air Force-unique environmental compliance, site remediation, and pollution prevention problems. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates advanced technologies to address Air Force environmental problems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) CONGRESSIONAL ADD: MPOI for Battlespace Information Exchange.	0.000	1.873	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Conduct Congressionally-directed effort for MPOI for Battlespace Information Exchange.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	0.000	1.873	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:
Not Applicable.

(U) D. Acquisition Strategy

Not Applicable.

PE NUMBER: 0603789F
PE TITLE: C3I Advanced Development

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BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603789F C3I Advanced Development

Cost ($ in Millions)		FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	31.595	41.124	35.785	31.161	38.298	38.372	43.498	Continuing	TBD
4072	Dominant Battlespace Awareness	14.853	13.538	10.353	9.648	10.187	10.459	10.717	Continuing	TBD
4216	Battlespace Information Exchange	8.820	12.404	8.537	9.031	10.732	10.265	14.895	Continuing	TBD
4872	Aerospace Information Dominance	6.123	15.182	16.895	12.482	17.379	17.648	17.886	Continuing	TBD
4925	Collaborative Info Superiority	1.799	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: Funds for the FY 2006 Congressionally-directed Massively Parallel Optical Interconnects for Battlespace Information Exchange in the amount of $1.900 million are in the process of being moved to PE 0603789F, C3I Advanced Development, from PE 0603723F, Environmental Engineering Technology, for execution. Funds for the FY 2006 Congressionally-directed Massively Parallel Optical Interconnects for Micro-Satellite Datacom in the amount of $1.000 million are in the process of being moved to PE 0603789F, C3I Advanced Development, from PE 0207423F, Advanced Communications Systems, for execution. Funds for the FY 2006 Congressionally-directed Hybrid Radio Frequency - Optical Communications Terminal in the amount of $1.000 million are in the process of being moved to PE 0603789F, C3I Advanced Development, from PE 0603211F, Aerospace Technology Development and Demonstration, for execution. Funds for the FY 2006 Congressionally-directed Air Operations Center Secured Data Access in the amount of $1.700 million are in the process of being moved to PE 0603231F, Crew Systems and Personnel Protection Technology, from PE 0603789F, C3I Advanced Development, for execution.

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates Aerospace Command, Control, Communications, and Intelligence (C3I) technologies for the warfighter. The technologies address the ability to support the global information exchange of correlated and fused information to ensure the Air Force can plan and execute missions in a dynamic environment. The Dominant Battlespace Awareness project will provide affordable operational data capabilities for personnel to understand militarily relevant situations, on a consistent basis, with the precision and timeliness needed to accomplish the mission. The Battlespace Information Exchange project will develop the reliable, secure, jam-resistant, inter-operable worldwide global information enterprise capabilities, providing the Air Force assured communications and reach-back capability in a joint/coalition environment. The Aerospace Information Dominance project provides the technology and demonstrations needed to allow the warfighter to plan, assess, execute, monitor, and re-plan on the compressed time scales required for tomorrow's conflicts, whether they be combat or peacekeeping missions. The Collaborative Info Superiority project provides the technology and demonstrations needed to establish virtual, distributed Air Operations Centers (AOC), allowing the majority of the AOC resources to remain in the Continental United States, while only a small command element is deployed forward. The resultant products of this program will be technologies needed to build the capability to dynamically plan and replan over a secure network. Note: In FY 2006, Congress added $1.3 million for Battlespace Information Exchange, $1.6 million for Enable Network Centric Warfare, $1.0 million for Griffith Institute - Accelerated Course in Engineering, $1.2 million for Information for Global Reach, $1.0 million for Massively Parallel Optical Interconnects for Battlespace Datacom, $1.0 million for National Center for Multi-Source Information Fusion Research, $2.8 million for Net-Centric Dissimilar Data Fusion Program, $1.9 million for Massively Parallel Optical Interconnects for Battlespace Information Exchange (originally appropriated to PE 0603723F, Environmental Engineering Technology) ,$1.0 million for Massively Parallel Optical Interconnects for Micro-Satellite Datacom (originally appropriated to PE 0207423F, Advanced Communications Systems) and $1.0 million for Hybrid Radio Frequency - Optical Communications Terminal (originally appropriated to PE 0603211F, Aerospace Technology Development and Demonstration.) An additional

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603789F C3I Advanced Development**

$1.7 million was appropriated to this PE for Air Operations Center Secured Data Access, but it has been moved to PE 0603231F, Crew Systems and Personnel Protection Technology, for execution.

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing upgrades and/or new system developments that have military utility and address warfighter needs.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	35.774	30.125	37.365
(U)	Current PBR/President's Budget	31.595	41.124	35.785
(U)	Total Adjustments	-4.179	10.999	
(U)	Congressional Program Reductions		-0.007	
	Congressional Rescissions	-0.032	-0.594	
	Congressional Increases		11.600	
	Reprogrammings	-3.313		
	SBIR/STTR Transfer	-0.834		

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE: 4072 Dominant Battlespace Awareness	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4072 Dominant Battlespace Awareness	14.853	13.538	10.353	9.648	10.187	10.459	10.717	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the FY 2006 Congressionally-directed Air Operations Center Secured Data Access in the amount of $1.7 million are in the process of being moved to PE 0603231F, Crew Systems and Personnel Protection Technology, from PE 0603789F, C3I Advanced Development, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops, integrates, and demonstrates advanced technologies to achieve Dominant Battlespace Awareness (DBA) and Predictive Battlespace Awareness (PBA) using information from all sources, exploiting government and commercial technologies in support of the Global Strike Concept of Operations (CONOPS) and the Space and Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance CONOPS. DBA is the information required to support dynamic planning and execution with the accuracy, fidelity, and timeliness needed to dominate in battle. Technology development includes: tasking information collectors (intelligence, surveillance, and reconnaissance platforms, national intelligence sources, etc.); correlating and geo-registering the collected data; exploiting the data to extract information of military significance; fusing information from multiple sources to create a digital representation of the battlespace; assessing the situation; predicting enemy course of action; and archiving the results for ready use by decision makers. This is a dynamic process that involves technologies for information access, extraction, fusion, processing, storage, and retrieval, as well as technologies for machine reasoning, pattern recognition, and timeline analysis.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate advanced signal and data exploitation technologies for detection, tracking, identification, and targeting of time-critical targets, and information extraction technologies for situational awareness.	2.948	1.721	2.732

(U) In FY 2005: Completed development and demonstration of intermediate information extraction tools and initiated development of advanced text exploitation tools that automatically extract events and their relationships from free text, including human intelligence and communication intelligence sources, allowing the warfighter more time to perform analysis. Continued to develop and deliver an exploitation toolkit for advanced ISR platforms that provide the detection and tracking of air and ground targets. Delivered tools for the exploitation of High Range Resolution, Identification Friend or Foe, and Synthetic Aperture Radar sensor characteristics for feature aided tracking and targeting. Continued to develop and deliver automated sensor management tools to support collection planning for ISR platforms. Initiated development of algorithms for the dynamic tasking of ISR assets (Unmanned Air Vehicle/Manned/Space ISR collectors) based upon the exploitation and fusion of multi-source and multi-platform information, in order to provide timely dissemination of useable intelligence to allied/coalition forces.

(U) In FY 2006: Develop a baseline capability to perform advanced text exploitation of Human Intelligence (HUMINT) reports and correlate and fuse the information with information from other sources. Develop and assess the ability to

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE 4072 Dominant Battlespace Awareness

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
extract actionable information from voluminous textual data.			
(U) In FY 2007: Complete and demonstrate a baseline capability to perform advanced text exploitation of HUMINT reports and correlate and fuse the information with information from other sources. Complete development and assessment of prototype that is able to extract actionable information from voluminous textual data.			
(U)			
(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced data handling, event visualization technologies, and distributed data fusion to enable a more effective utilization of the vast amounts of data available to intelligence analysts to provide optimized situation awareness, as well as to support all phases of combat operations. This effort includes $1.0 million in FY 2006 Congressional Add funding.	3.341	5.365	4.080
(U) In FY 2005: Completed development of probabilistic approaches for accumulation of data/information to support target/activity identification and situation awareness in support of PBA. Completed development and deliver tools for timeline, event, and motion pattern recognition to support analysis, visualization, and decision aids to detect enemy activity. Continued to develop an operations-based approach for intelligent and adaptive intelligence, surveillance, and reconnaissance (ISR) management based upon quantified information deficiencies in the fused data-space. Continued to develop and deliver an initial fusion evaluation environment, providing for the analysis, evaluation, and transition of fusion products to the warfighter.			
(U) In FY 2006: Continue to develop and deliver a fusion evaluation environment, providing simulation and modeling capability, measures of performance, and operator focused transition products to support the warfighter. Develop an automated process to visualize the overlaying of disparate information domains on a single screen and provide an optimal means of fusing all source intelligence data. Develop and demonstrate advanced fusion tools to enhance the capability for PBA. Use operator focused techniques to evaluate the effectiveness of the fusion tools. Perform feature aided tracking to monitor, assess, and predict possible courses of action. Initiate development of reasoning algorithms and evidence accrual techniques for continuous knowledge development of the battlespace. Conduct Congressionally-directed effort for National Center for Multi-Source Information Fusion Research.			
(U) In FY 2007: Continue to enhance the evaluation environment for assessing the state-of-the-art and maturity of algorithms for transition to the warfighter. Demonstrate an automated process to visualize the overlaying of disparate information domains on a single screen and provide an optimal means of fusing all source intelligence data. Complete demonstration of feature aided tracking to monitor, assess, and predict possible courses of action. Complete development and demonstrate operator focused dynamic resource allocation algorithms and techniques for optimization and collaboration of information products. Initiate development of adversarial behavior prediction tools using multiple sources of intelligence (multi-INT) fusion, situational awareness, and cross cueing ISR techniques.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE 4072 Dominant Battlespace Awareness

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced data and information fusion capabilities to support multi-source capabilities, new sensor types, cognitive models, and automated fusion process management. Note: The funding profile reflects the completion of multi-INT fusion efforts and shifting to fusion driven ISR management research in FY 2006. The funding profile in FY 2007 reflects demonstrations of multi-platform tracking and ISR management. This effort contains $2.8 million in FY 2006 Congressional Add funding.	3.964	4.752	3.541
(U)	In FY 2005: Developed and demonstrated multiple intelligence source data mining and reasoning techniques to locate hard to find targets within the context of a continuously changing battlefield environment. Initiated development of approaches and techniques for reasoning about enemy movements and actions from historical databases and real-time multi-source information to be able to find, identify, and track difficult targets that employ concealment, camouflage, and deception techniques. Initiated an investigation of reasoning techniques to aid the analyst in understanding the dynamics of the battlefield.			
(U)	In FY 2006: Develop interoperable exploitation technologies for real-time ISR management. Enhance ISR resource management development through incorporation of information sharing and network centric operations. Develop tools for mission/task based priority and quality of service utilization of assets and fusion focused ISR tasking, and explore the synergy between the two. Perform a multi-platform interoperability and limited tracking demonstration, which integrates resource management, information management, and communications management capability. Conduct Congressionally-directed effort for Net-Centric Dissimilar Data Fusion Program.			
(U)	In FY 2007: Complete development of interoperable exploitation technologies for real-time ISR management, which incorporates non-traditional ISR into the management algorithms for find, fix, track, target, engage, and access. Perform a multi-platform tracking demonstration utilizing airborne assets against a variety of advanced military and asymmetric threat scenarios. Demonstrate the capability to dynamically task sensors and assure timely, prioritized transport of information for purpose of tracking high value ground targets for long durations and potentially engaging them.			
(U)				
(U)	CONGRESSIONAL ADD: Collaborative Archive System.	1.000	0.000	0.000
(U)	In FY2005: Developed and demonstrated a collaboration system which applies modern collaboration tools and technologies towards the problem of information discovery and information sharing between the Air Force and other organizations. The ability to collaborate across security boundaries using instant messaging, shared whiteboard, and audio teleconferencing tools, and to quickly discover pertinent information from prior collaborative sessions was emphasized.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE 4072 Dominant Battlespace Awareness

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY2006: Not Applicable.			
(U)	In FY2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Dynamic Targeting Capability.	1.500	0.000	0.000
(U)	In FY2005: Developed and demonstrated an enhanced capability for the Air Force to identify, plan, and attack emerging threats as it operates in a Network Centric architecture. This capability possesses the tools necessary to discover, translate, and share metadata and products from intelligence databases, weapons evaluation, image exploitation, and target visualization systems, as well as non-traditional ISR sources to quickly assist in identifying threats or propose a course of action.			
(U)	In FY2006: Not Applicable.			
(U)	In FY2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Advanced Wideband Processor and High Frequency (HF) Geo-Processor (AWP/HGP) for RIVET JOINT Aircraft.	2.100	0.000	0.000
(U)	In FY2005: Completed development, integration, flight testing, and installation of an AWP/HGP on a RIVET JOINT aircraft with the AWP providing theater-wide detection and processing of high-interest signals in dense, co-channel environments typical of commercial communications, and the HGP adding direction finding and geo-location of HF signals to RIVET JOINT capabilities.			
(U)	For 2006: Not Applicable.			
(U)	For 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Air Operations Center Secured Data Access.	0.000	1.700	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Air Operations Center Secured Data Access.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	14.853	13.538	10.353

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602702F, Command,									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603789F C3I Advanced Development**	PROJECT NUMBER AND TITLE **4072 Dominant Battlespace Awareness**

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

Control, and Communications.

(U) PE 0603203F, Advanced Aerospace Sensors.

(U) PE 0603742F, Combat Identification Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE: 4216 Battlespace Information Exchange

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4216 Battlespace Information Exchange	8.820	12.404	8.537	9.031	10.732	10.265	14.895	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Funds for the FY 2006 Congressionally-directed Massively Parallel Optical Interconnects for Battlespace Information Exchange in the amount of $1.9 million are in the process of being moved to PE 0603789F, C3I Advanced Development, from PE 0603723F, Environmental Engineering Technology, for execution. Funds for the FY 2006 Congressionally-directed Massively Parallel Optical Interconnects for Micro-Satellite Datacom in the amount of $1.0 million are in the process of being moved to PE 0603789F, C3I Advanced Development, from PE 0207423F, Advanced Communications Systems, for execution. Funds for the FY 2006 Congressionally-directed Hybrid Radio Frequency - Optical Communications Terminal in the amount of $1.0 million are in the process of being moved to PE 0603789F, C3I Advanced Development, from PE 0603211F, Aerospace Technology Development and Demonstration, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced communications technologies to implement a secure information grid for the worldwide information exchange of near-real-time multimedia (i.e., voice, data, video, and imagery) information in a joint/coalition environment. This secure information grid will be rapidly deployable, mobile, interoperable, and seamless between aircraft, either en route or in theater, and Air Operations Centers. It will: a) provide interoperability across echelon, Service, and multi-national force boundaries; b) support mobile information superiority, sensor-to-shooter operations, and the battle management decision process; and c) provide in-transit visibility of en route aircraft, cargo, mission status, and reachback capabilities for aircraft to operations centers in the Continental United States (e.g., updating information and mission changes to en route aircraft). Technology developments include an information assurance decision support system, advanced information management, multi-level secure communications, secure survivable networks, mission and content-based routing, quality-of-service mechanisms, and communications transmission systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate secure wideband assured networking for munitions (e.g., Joint Direct Attack Munition, etc.) and integration with the developing airborne segment of the Global Grid.	2.264	3.299	3.878
(U) In FY 2005: Designed and brassboarded affordable high-capacity data links that were miniaturized to fit within the confines of miniature munitions. Data networking supported command and control of the munition and cooperative situational awareness and battle damage assessment with other weapon platforms.			
(U) In FY 2006: Examine and develop or adapt networked communications to support Special Operations Forces (SOF) ground elements connecting them into the Airborne Network to weapon platforms and reachback to globally located command centers.			
(U) In FY 2007: Continue to develop or adapt networked communications to support SOF ground elements connecting them into the Airborne Network to weapon platforms and reachback to globally located command centers.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate an enterprise management system that collects and evaluates status	0.479	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE 4216 Battlespace Information Exchange

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	information from multiple systems and sources, monitors enterprise integrity, analyzes situations, and displays enterprise-wide information. Note: Effort completed in FY 2005.			
(U)	In FY 2005: Completed the demonstration of an enterprise management system that collects and evaluates status information from multiple systems in multiple security domains to display enterprise-wide information without compromising security in the individual domains.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced expert system decision algorithms to prioritize and control resources for global reach in the Air Mobility Command (AMC) environment. This effort contains $2.8 million in FY 2006 Congressional Add funding.	1.772	3.588	0.540
(U)	In FY 2005: Continued development of the Intelligent Information Manager, Integrated Network Controller, and the Global Media Access Controller into a software application for a software defined radio in preparation for transitioning the capability to the Joint Tactical Radio System clusters.			
(U)	In FY 2006: Transition the combined Intelligent Information Manager, Integrated Network Controller, and the Global Media Access Controller to jumpstart Network Centric communications. Conduct Congressionally-directed efforts for Information for Global Reach, and Enable Network Centric Warfare.			
(U)	In FY 2007: Complete the transition of the combined Intelligent Information Manager, Integrated Network Controller, and the Global Media Access Controller to jumpstart Network Centric communications.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate intelligent networking transport and management technology to provide assured, seamless, battlespace connectivity to the aerospace forces with a greatly reduced footprint. Note: This effort includes $2.0 million in FY 2005 and $1.0 million in FY 2006 Congressional Add funding.	3.305	4.517	4.119
(U)	In FY 2005: Studied, defined, and developed mission and content delivery network mechanisms. Refined and enhanced intelligent networking technology, which adapts to its environment and varying demands for service, while providing mission and context-based quality-of-service (QoS) routing. Merged wideband wireless intelligent networking with context-based QoS routing and fashion for ease of implementation into, and the expansion of, the common Joint Service Network Service Layer. Developed and demonstrated an efficient on-board optical interconnectivity solution that addresses, in a uniform manner, all intra-platform communications, to include telemetry/command/control, and payload related data exchange needs of an Unmanned Air Vehicle (UAV) platform.			
(U)	In FY 2006: Develop mechanisms to enable integrated management of communications and sensor resources.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE 4216 Battlespace Information Exchange

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	Assess communications needed to support ground moving target tracking, multi-intelligence exploitation and fusion, and sensor resource management systems and techniques. Establish a framework for integration and development of a common-coordinated management function for command, control, intelligence, surveillance, and reconnaissance networking. Develop mission/task based priority and quality of service utilization of communications assets to enable fusion-focused ISR tasking, feature-aided tracking, group tracking, and use of Level 3 type fusion information. Investigate the complexities of multi-intelligence exploitation and incorporate enhancements into the development. Continue to develop aand demonstrate an efficient on-board optical interconnectivity solution that addresses, in a uniform manner, all intra and inter-platform communications, to include telemetry/command/control, and payload related data exchange needs of UAV and micro satellite platforms.			
(U)	In FY 2007: Demonstrate multi-platform tracking, employing multiple ISR platforms, that show improved battle management command, control, and communications capabilities and complete assessment of the warfighter effectiveness of integrated ISR sensor management/fusion and communications capability. Continue to develop and demonstrate a survivable, mobile, deployable extension of the Global Information Grid to support rapid, decisive and sustainable air power, C2, weapons data links, and ISR assets.			
(U)				
(U)	CONGRESSIONAL ADD: Cyber Security - Advanced Course In Engineering.	1.000	0.000	0.000
(U)	In FY2005: Developed training program in cyber security through the completion of research topics covering the areas of security policy, computer security, cryptography, steganography, digital forensics, network security, network defense, network attack, wireless security, and next generation security.			
(U)	In FY2006: Not Applicable.			
(U)	In FY2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Griffith Institute - Accelerated Course in Engineering.	0.000	1.000	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Griffith Institute - Accelerated Course in Engineering.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	8.820	12.404	8.537

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE 4216 Battlespace Information Exchange

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602702F, Command, Control, and Communications.

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE 4872 Aerospace Information Dominance	

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4872 Aerospace Information Dominance	6.123	15.182	16.895	12.482	17.379	17.648	17.886	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: Increased funding in FY 2006 and out reflects increased emphasis on developing high payoff information distribution and effects-based planning technologies. In FY 2006, efforts from Project 4925 move to this Project.

(U) A. Mission Description and Budget Item Justification

In order to achieve information dominance for the Expeditionary Aerospace Force, the Air Force must be able to plan, assess, monitor, and replan missions rapidly in a dynamic environment. This project develops and demonstrates technologies necessary for dynamic decision making. It provides the technology and demonstrations needed to enable the warfighter to plan, assess, execute, monitor, and replan on the compressed time scales required for tomorrow's conflicts, whether they be combat or operations other than war. It will develop and demonstrate a new generation of planning assessment technologies that enable a new paradigm of effects-based operations, allowing the aerospace commanders to determine the desired operational effects and prosecute the mission accordingly. It will develop innovative capabilities capable of realizing a strategy to task approach to aerospace warfare exploiting a link between command, strategy, and assessment functions. It will develop and demonstrate distributed information technologies that provide the commander and staff with seamless access to tailored multi-media, multi-spectral data within a mobile, dynamic Air Operations Center (AOC). Knowledge-based intelligent information technologies will be developed to support robust, real-time, large-scale Air Force command and control (C2) systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate distributed information technologies that are scalable and reconfigurable and provide seamless access to tailored multi-media, multi-spectral data for commanders and staff in mobile, dynamic C2 centers. Note: Yearly increasing funding is due to increased emphasis in developing and demonstrating to the warfighter the baseline functionality of the Advanced Technology AOC.	1.568	4.067	5.499

(U) In FY 2005: Continued to design and develop a baseline of critical functionality and supporting infrastructure that will support the evolving Advanced Technology AOC weapon system and its split operations concept. Initiated and developed a capability for the commander to monitor, and repair where necessary, the health of the information superiority function within the AOC weapon system. Investigated the demonstration of a core set of functionality and supporting infrastructure of an Advanced Technology AOC weapon system enabling the ability to plan, direct, coordinate, and control air forces and operations across security boundaries. Initiated and developed an automatic options generation capability for correcting failures and degradations within the C2 system of the Advanced Technology AOC weapon system. Initiated and developed highly efficient business processes and tools to support information exchange between the AOC and other C2 centers in the Theater Air Control Structure.

(U) In FY 2006: Continue to investigate a core set of functionality and supporting infrastructure of the next generation AOC weapon system enabling the ability to plan, direct, coordinate, and control air forces and operations across

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE 4872 Aerospace Information Dominance

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
security boundaries in a coalition environment. Develop joint Service collaborative planning of mission packages with tailorable and exportable information reports/briefings associated with air space management and deconfliction. Continue developing highly efficient business processes and tools to support information exchange between the AOC and other C2 centers in the Theater Air Control Structure. Explore the integration of intelligent agents that use physics-based modeling to provide accurate, detailed advice necessary to make correct decisions. Apply appropriate system of systems and federation of systems engineering principles to create joint C2 decision-support capabilities.			
(U) In FY 2007: Continue to investigate a core set of functionality and supporting infrastructure, including multi-level security repositories, of the next generation AOC weapon system enabling the ability to plan, direct, coordinate, and control air forces and operations across security boundaries in a coalition environment. Develop execution of the airspace plan and re-planning options with faster than real-time fly out of Air Tasking Orders that can be performed in less time than it takes the aircraft to reach the airspace in question so that it can be dynamically de-conflicted; thus avoiding a possible hazardous condition. Continue developing highly efficient business processes and tools to support information exchange between the AOC and other C2 centers in the Theater Air Control Structure. Prototype and demonstrate intelligent agents that use physics-based modeling to provide accurate, detailed advice necessary to make correct decisions. Continue to develop and apply system of systems and federation of systems engineering principles to create joint C2 decision-support capabilities.			
(U)			
(U) MAJOR THRUST: Develop and demonstrate the integration of planning tools and information-based intelligent agents for adaptive replanning and decision support tools for aerospace C2 systems.	0.299	2.358	4.003
(U) In FY 2005: Began developing tools and technologies to revolutionize air mobility information superiority to respond swiftly and effectively to global demands across all spectrums of operations from humanitarian relief to a major conflict. Enabled the capability to rapidly synchronize theater information superiority capabilities between combat and mobility forces to support time-critical mobility and the seamless interoperability of DoD, civil, and coalition units for air traffic control. Initiated development of advanced reasoning techniques for mobility courses-of-action development. Explored the use of advanced computer mark-up languages and initiated the development of common mobility ontology to improve automation of the decision support tools for increased situational awareness, planning, and execution management.			
(U) In FY 2006: Continue developing tools and technologies to revolutionize air mobility information superiority to respond swiftly and effectively to global demands across all spectrums of operations from humanitarian relief to a major conflict. Continue development of advanced reasoning techniques for mobility courses-of-action development. Apply the use of advanced computer mark-up languages and continue the development of common mobility ontology to improve automation of the decision support tools for increased situational awareness, planning,			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE 4872 Aerospace Information Dominance

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
and execution management. Investigate the feasibility of a capability-centric versus system/program-centric global warfighting response by "bridging the seams" between disparate processes and systems in the Combat Air Force (CAF), Mobility Air Force (MAF), and Civil Air Traffic Management (ATM) domains. Develop improved synchronization among Global Strike and Global Mobility Force participants within multiple theaters and global Civil ATM. Develop the capability to support collaborative C2, including dynamic and intermittent participation of players possibly in a coalition setting. Develop innovative automated machine-to-machine exchange of selected information between CAF aircraft, MAF aircraft, their respective C2 elements, and civil ATM agencies. Explore the feasibility of virtual staff members to maintain a vision of C2 processes during human absences providing a 24/7 coverage.			
(U) In FY 2007: Continue development of tools and technologies to revolutionize air mobility information superiority to respond swiftly and effectively to global demands across all spectrums of operations from humanitarian relief to a major conflict. Complete development of advanced reasoning techniques for mobility courses-of-action development. Demonstrate the use of advanced computer mark-up languages and continue the development of common mobility ontology to improve automation of the decision support tools for increased situational awareness, planning, and execution management. Develop and demonstrate a CAF, MAF, civilian shared situational awareness/synchronization to achieve desired "effects" and ensure mission success in a global environment. Continue to develop improved synchronization among Global Strike and Global Mobility Force participants within multiple theaters and global Civil ATM. Demonstrate the capability to support collaborative C2, including dynamic and intermittent participation of players, possibly in a coalition setting. Continue to develop innovative automated machine-to-machine exchange of selected information between CAF aircraft, MAF aircraft, their respective C2 elements, and civil ATM agencies, and demonstrate improved information sharing and interoperability between CAF and MAF mission planning and execution systems for improved velocity, efficiency, safety, and mission success. Develop appropriate virtual staff members to maintain a vision of C2 processes during human absences providing a 24/7 coverage.			
(U)			
(U) MAJOR THRUST: Develop, demonstrate, and integrate a broad range of technologies that have application within embedded information architecture applicable to manned and unmanned vehicles. Note: In FY 2005, this effort was performed in Project 4925, first Major Thrust. In FY 2006, this effort completes.	0.000	0.830	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Develop a Time Sensitive Target automated decision-aiding capability for an Advanced Technology Aerospace Operations Center type of facility in a spiral fashion. Demonstrate in a real-time scenario such as Joint Expiditionary Force Experiment-2006.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE 4872 Aerospace Information Dominance

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate an effects-based approach for the next generation of planning and assessment techniques that enable aerospace commanders to determine the desired operational effects at the right place at the right time.	1.489	3.835	4.488
(U)	In FY 2005: Initiated the design of new concepts and technologies supporting effects-based planning, execution, and assessment by enabling the generation, tasking, and assessment of effects-based Dynamic Air Execution Orders. Investigated various capabilities to support AOC personnel in developing and assessing, in near-real-time, various course of action options based upon commander's intent and knowledge gained from predictive battlespace awareness tools and processes. Initiated the investigation of advanced information technologies to shorten the current execution timelines, while also allowing significant reductions in the number of personnel required in an AOC.			
(U)	FY 2006: Continue to develop new concepts and technologies supporting effects-based planning, execution, and assessment by enabling the generation, tasking, and assessment of effects-based Dynamic Air Execution Orders. Continue investigating various capabilities to support AOC personnel in developing and assessing, in near-real-time, various course of action options based upon commander's intent, predictive battlespace awareness tools, and an ability to reason over models of the enemy as a system. Continue to develop technologies to capture, assess, and integrate cause-and-effect (first, second, and third order) relationships endemic to this "enemy as a system." Continue investigation of advanced information technologies to shorten the current execution timelines, while also allowing significant reductions in the number of personnel required in an AOC. Develop warfighter-accepted operational concepts and architecture views for a Streaming Air Tasking Order (ATO) generator and dynamic effects-based assessment capability. Begin spiral developments of concept demonstrations of a Streaming ATO generation capability. This will enable more responsive and continuous planning, execution, and assessment within the AOC.			
(U)	FY 2007: Continue to develop new concepts, to include cyber operations concepts, and technologies supporting effects-based planning, execution, and assessment by enabling the generation, tasking, and assessment of effects-based Dynamic Air Execution Orders. Continue investigating various capabilities to support AOC personnel in developing and assessing, in near-real-time, various course of action options based upon commander's intent, predictive battlespace awareness tools, and an ability to reason over models of the enemy as a system. Continue to develop technologies to capture, assess, and integrate cause-and-effect (first, second, and third order) relationships endemic to this "enemy as a system." Complete investigation of advanced information technologies to shorten the current execution timelines, while also allowing significant reductions in the number of personnel required in an			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE 4872 Aerospace Information Dominance

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	AOC. Develop a streaming ATO prototype capability. Develop real-time operational assessment demonstration in a streaming ATO environment that will enable an effects-based approach to operational assessment, which will allow greater visibility into whether or not desired effects are being achieved.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD : Demonstrate how a publish, subscribe, and query information management paradigm can enable horizontal integration of Air Force command, control, communication, computers, intelligence, surveillance, and reconnaissance information systems. Develop more advanced prototypes of a Community Of Interest (COI) infosphere that support information management requirements of various Air Force net-centric COI's. Demonstrate how such an infosphere can interact with and enhance the current net-centric infrastructure. This effort includes$1.3 million in FY 2006 Congressional Add funding.	2.767	4.092	2.905
(U)	In FY 2005: Demonstrated techniques to manage thousands of information objects from diverse information sources and data environments within a command and control information space. Completed the integration and demonstration of information management services that enable information exchange among disparate information systems. Evaluated and demonstrated technologies that enable the selective dissemination of information objects across multiple security level boundaries. Developed and demonstrated an advanced COI infosphere prototype, with non-real-time pub/sub/query capability, as well as Role-based Access Control and persistence management.			
(U)	In FY 2006: Initiate development of new next generation COI infosphere prototype to provide real-time performance, security to Air Force standards, and high levels of scalability to meet Air Force net-centric operational needs. Support information engineering efforts allowing various existing and new Air Force systems to utilize these COI infosphere prototypes. Conduct Congressionally-directed efforts for Battlespace Information Exchange.			
(U)	In FY 2007: Continue development of new next generation COI infosphere prototype to provide real-time performance, security to Air Force standards, and high levels of scalability. Continue to support information engineering efforts allowing various existing and new Air Force systems to utilize these COI infosphere prototypes. Initiate study of power efficient processing to enhance the publish/subscribe methodology to legacy systems.			
(U)	Total Cost	6.123	15.182	16.895

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602702F, Command, Control, and Communications.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603789F C3I Advanced Development**	PROJECT NUMBER AND TITLE **4872 Aerospace Information Dominance**

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

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603789F C3I Advanced Development

PROJECT NUMBER AND TITLE: 4925 Collaborative Info Superiority

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4925 Collaborative Info Superiority	1.799	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2005, an effort in this Project moved to Project 4216. In FY 2006, efforts in this Project move to Project 4872 in this PE.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates technologies for the next generation of distributed collaborative environments, which will provide cross-disciplinary information to a decision-maker when, where, and how it is needed. Technologies developed will demonstrate advanced integrated information architectures for the near-real-time transfer of large volumes of information over existing and future Air Force Information Superiority systems. The application of these new technologies will allow reconfiguration and adaptation of existing operational aerospace systems to support seamless integrated operations.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop, demonstrate, and integrate a broad range of technologies that have application within an embedded information architecture applicable to manned and unmanned vehicles.	0.574	0.000	0.000
(U) In FY 2005: Continued the development of a TCT automated decision-aiding capability for an Advanced Technology AOC type of facility to deny the enemy the sanctuary of time. Continued development of airborne platform capabilities to engage in this environment either as information sources or sinks (on- and off-board resources) toward the end of assuring maximum exploitation of fielded assets in accomplishing the maximum strike responsiveness of the shooting elements for completing the TCT kill chain. Initiated the development of distributive collaborative environments for C2 warfighter decision making for a broad range of operations other than war, including modeling of non-combatant, neutral, and adversarial forces with social, economic, political, and cultural influences.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) MAJOR THRUST: Develop communication technologies to increase aerospace platform information transfer capacity.	0.625	0.000	0.000
(U) In FY 2005: Completed development and demonstration of an increased aerospace platform information transfer capacity exchange of time-critical threat, sensor, and C2 information between aircraft and cooperating space, airborne, and surface communication assets. Note: In FY 2005, the development of an initial munitions data link capability moved to Project 4216.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U)			

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE: 4925 Collaborative Info Superiority

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	MAJOR THRUST: Develop and demonstrate embedded information system technologies to support a transparent framework for seamless, rapid insertion of battlespace infosphere technology.	0.600	0.000	0.000
(U)	In FY 2005: Continued development of embedded information technology to support the AOC management of unmanned and autonomous systems.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	1.799	0.000	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0602702F, Command, Control, and Communications.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0603850F
PE TITLE: Integrated Broadcast Service (DEM/VAL)

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603850F Integrated Broadcast Service (DEM/VAL)

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	2.235	0.000	0.000	0.000	0.000	0.000	0.000	0.000	17.876
5151 Blue Force Tracking	2.235	0.000	0.000	0.000	0.000	0.000	0.000	0.000	17.876

In FY2004, Project Number 635151, Joint Blue Force Situation Awareness (JBFSA) Advanced Concept Technology Demonstration (ACTD), efforts were transferred from PE0207028F, Joint Expeditionary Force Experiment (JEFX), Project Number 674991, Joint Distributed Engineering Plant. Although this PE is entitled "Integrated Broadcast Service (IBS)", this project does not use IBS funding. Description of the IBS program is provided in PE 63850F, Budget Activity 4.

(U) A. Mission Description and Budget Item Justification

JBFSA ACTD - This Army run JBFSA ACTD, a continuation of an ACTD started in CY2003, will focus on the integration of disparate systems (no single system or mission application exists today), data interoperability and common operating displays. Tasks include the development, integration, validation, and transition of web-enabled Common Operating Picture (COP) and User Defined Operating Picture (UDOP) capabilities for Joint Blue Force Tracking. Specific sub-areas include the integration of current JBFSA devices into the JBFSA architecture, disseminate and display a consistent blue force picture within the Global Command and Control Systems (GCCS) family of systems (FOS) COP and select tactical level display devices, identification of additional JBFSA data dissemination paths (satellite communications (SATCOM), Global Broadcast Service (GBS), Integrated Broadcast Service (IBS), Tactical networks, etc.), integration of line-of-sight (LOS) receivers into the JBFSA architecture including aircraft, unmanned aerial vehicles (UAVs) and aerostats, field an enhanced Mission Management Center (MMC) capability, and serve as the benchmark/set the stage to evaluate multi-level security challenges and the dissemination of select JBFSA data to Coalition COP devices. All candidate solutions will be validated before transitioning to the services for sustainment and extended user evaluation.

This PE paid for "Technical Assistance" to the JBFSA ACTD, and ultimately it led to the development of the Data Strategy called Cursor on Target (CoT), which enables disparate systems to pass "What, Where, When" data by using adaptors on each of the systems. The Systems of record can change in the future and not have to do a complete software upgrade. This capability has been installed in the Marines Command and Control PC (C2PC), the Air Force's Combat Track II system, Raindrop, and in several UAVs. This allows these systems to communicate this data by simply pointing to an IP address to provide Joint Blue Force Situational Awareness data. This portion of the overall JBFSA ACTD has been completed and results have been transferred to the Army.

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing systems.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603850F Integrated Broadcast Service (DEM/VAL)

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	2.268	0.000	0.000
(U)	Current PBR/President's Budget	2.235	0.000	0.000
(U)	Total Adjustments	-0.033	0.000	
(U)	Congressional Program Reductions			
	Congressional Rescissions			
	Congressional Increases			
	Reprogrammings	-0.033		
	SBIR/STTR Transfer			

(U) Significant Program Changes:

This portion of the overall JBFSA ACTD has been completed.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603850F Integrated Broadcast Service (DEM/VAL)	PROJECT NUMBER AND TITLE: 5151 Blue Force Tracking

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5151 Blue Force Tracking	2.235	0.000	0.000	0.000	0.000	0.000	0.000	0.000	17.876
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

In FY2004, Project Number 635151, Joint Blue Force Situation Awareness (JBFSA) Advanced Concepts Technology Demonstration (ACTD), efforts were transferred from PE0207028F, Joint Expeditionary Force Experiment (JEFX), Project Number 674991, Joint Distributed Engineering Plant. Although this PE is entitled "Integrated Broadcast Service (IBS)", this project does not use IBS funding. Description of the IBS program is provided in PE 63850F, Budget Activity 4.

(U) A. Mission Description and Budget Item Justification

JBFSA ACTD - This Army run JBFSA ACTD, a continuation of an ACTD started in CY2003, will focus on the integration of disparate systems (no single system or mission application exists today), data interoperability and common operating displays. Tasks include the development, integration, validation, and transition of web-enabled Common Operating Picture (COP) and User Defined Operating Picture (UDOP) capabilities for Joint Blue Force Tracking. Specific sub-areas include the integration of current JBFSA devices into the JBFSA architecture, disseminate and display a consistent blue force picture within the Global Command and Control Systems (GCCS) family of systems (FOS) COP and select tactical level display devices, identification of additional JBFSA data dissemination paths (satellite communications (SATCOM), Global Broadcast Service (GBS), Integrated Broadcast Service (IBS), Tactical networks, etc.), integration of line-of-sight (LOS) receivers into the JBFSA architecture including aircraft, unmanned aerial vehicles (UAVs) and aerostats, field an enhanced Mission Management Center (MMC) capability, and serve as the benchmark/set the stage to evaluate multi-level security challenges and the dissemination of select JBFSA data to Coalition COP devices. All candidate solutions will be validated before transitioning to the services for sustainment and extended user evaluation.

This PE paid for "Technical Assistance" to the JBFSA ACTD, and ultimately it led to the development of the Data Strategy called Cursor on Target (CoT), which enables disparate systems to pass "What, Where, When" data by using adaptors on each of the systems. The Systems of record can change in the future and not have to do a complete software upgrade. This capability has been installed in the Marines Command and Control PC (C2PC), the Air Force's Combat Track II system, Raindrop, and in several UAVs. This allows these systems to communicate this data by simply pointing to an IP address to provide Joint Blue Force Situational Awareness data. This portion of the overall JBFSA ACTD has been completed and results have been transferred to the Army.

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) Accomplishments Planned Program	0.000		
(U) Engineering, Integration & Testing	0.570		
(U) Demonstration/Exercise Support	0.527		
(U) CONOPS/Tactics, Techniques, and Procedures (TTP) & Documentation Development	0.262		
(U) Purchase/Lease and Installation of BFT Devices, Training, and Purchase of SATCOM air time			
(U) Transition Support	0.750		
(U) Maintain a Program Management Office, including financial and demonstration supervision	0.126		

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603850F Integrated Broadcast Service (DEM/VAL)**	PROJECT NUMBER AND TITLE **5151 Blue Force Tracking**

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
(U)	FIOP JBFSA Integrated Architecture Development and Interoperability enhancements	0.000		
(U)	Total Cost	2.235	0.000	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Not Applicable									

(U) D. Acquisition Strategy

The Acquisition Strategy for this effort will be to use existing precompeted contracts and add task/delivery orders to them.

PE NUMBER: 0603924F
PE TITLE: High Energy Laser Advanced Technology Program

Exhibit R-2, RDT&E Budget Item Justification	DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603924F High Energy Laser Advanced Technology Program

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	9.490	5.713	3.713	3.781	4.106	4.200	4.272	Continuing	TBD
5095	High Energy Laser Advanced Technology Program	9.490	5.713	3.713	3.781	4.106	4.200	4.272	Continuing	TBD

(U) A. Mission Description and Budget Item Justification

This program funds high energy laser (HEL) advanced technology development through the HEL Joint Technology Office (JTO). HEL weapon systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and the ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall Department of Defense (DoD) HEL Science and Technology program. In general, efforts funded under this program are chosen for their potential to have major impact on multiple HEL systems and on multiple Service missions while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics, propagation, and free electron lasers. This program is in Budget Activity 3, Advanced Technology Development, since it enables and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	9.760	5.801	3.671
(U)	Current PBR/President's Budget	9.490	5.713	3.713
(U)	Total Adjustments	-0.270	-0.088	
(U)	Congressional Program Reductions		-0.005	
	Congressional Rescissions	-0.007	-0.083	
	Congressional Increases			
	Reprogrammings			
	SBIR/STTR Transfer	-0.263		
(U)	Significant Program Changes:			

C. Performance Metrics
Under Development.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603924F High Energy Laser Advanced Technology Program	PROJECT NUMBER AND TITLE: 5095 High Energy Laser Advanced Technology Program

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5095	High Energy Laser Advanced Technology Program	9.490	5.713	3.713	3.781	4.106	4.200	4.272	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This program funds high energy laser (HEL) advanced technology development through the HEL Joint Technology Office (JTO). HEL weapon systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and the ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall Department of Defense (DoD) HEL Science and Technology program. In general, efforts funded under this program are chosen for their potential to have major impact on multiple HEL systems and on multiple Service missions while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics, propagation, and free electron lasers. This program is in Budget Activity 3, Advanced Technology Development, since it enables and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop solid state lasers that have potential as future HEL weapon laser devices because of their inherent small size and the fact that they require only electrical energy in order to run, thereby greatly simplifying systems engineering and supportability.	5.960	4.102	2.877

(U) In FY 2005: Participated in the Joint High Power Solid State Laser (JHPSSL) project and demonstrate three 25 kilowatt lasers. Developed test hardware for and conduct independent, government testing of these lasers. Factors such as performance, cost, etc. were evaluated between the various approaches funded by the Army, Air Force, and HEL JTO. Developed a design for a 100 kilowatt laser. Conducted a proposal call for the 100 kilowatt JHPSSL, performed the selection process, and initiated funding to one or more contractors. Developed high-power laser component technology addressing all elements of the laser (e.g., diode pump lasers, wavefront control technology, thermal control, beam combining technology, etc.). Conducted Service and Agency proposal call for FY 2005 and funded first year of selected efforts.

(U) In FY 2006: Continue to participate in the JHPSSL effort to demonstrate 100 kilowatts. Assess advanced configurations for power scaling such as combined fiber lasers. Conduct necessary studies to understand and improve fieldability of solid state lasers. Continue to assemble successful pieces from individual applied research projects (e.g., long-life diode-laser drivers, thin-disk amplifiers, phase-conjugate mirrors, mist cooling) into an advanced demonstration of solid state laser sub-systems. Conduct an industry proposal call for FY 2006, fund first

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603924F High Energy Laser Advanced Technology Program	PROJECT NUMBER AND TITLE 5095 High Energy Laser Advanced Technology Program

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	year of selected efforts, and fund second year of FY 2005 Service and Agency efforts.			
(U)	In FY 2007: Continue to participate in the JHPSSL project to demonstrate a 100 kilowatt laser. The 100 kilowatt demonstration(s) will occur during this period. Provide for independent, government-sponsored measurement of the 100 kilowatt laser(s). Explore the need for other high value experiments to follow the 100 kilowatt program and begin planning as appropriate. Continue the component development program with emphasis on improvement of existing power-scaling architectures as well as next generation components and architectures. Continue to fund the contract efforts started in FY 2006, conduct Service and Agency proposal call for FY 2007, and fund first year of selected efforts.			
(U)				
(U)	MAJOR THRUST: Develop beam-control technologies for surface, air, and space mission areas, as well as develop supporting technologies.	2.175	0.429	0.330
(U)	In FY 2005: Maintained the component development program. Planned for a high-value integrated beam control demonstration that would use successful pieces from individual applied research projects (e.g., deformable mirrors, wavefront sensors, advanced tracking and compensation algorithms) and specifically address tactical applications. Conducted Service and Agency proposal call for FY 2005 and funded first year of selected efforts.			
(U)	In FY 2006: Continue component development program and pursuit of an integrated beam control demonstration addressing tactical applications. Conduct an industry proposal call for FY 2006, fund first year of selected efforts, and fund second year of FY 2005 Service and Agency efforts.			
(U)	In FY 2007: Continue pursuit of an integrated beam control demonstration addressing tactical applications. Address advanced beam control architectures and algorithms that have not already been tested in the integrated beam control demonstration. Continue to fund the contract efforts started in FY 2006, conduct Service and Agency proposal call for FY 2007, and fund first year of selected efforts.			
(U)				
(U)	MAJOR THRUST: Develop free electron laser (FEL) technologies that scale to high power and permit FELs to be fielded on military platforms.	0.968	1.182	0.506
(U)	In FY 2005: Demonstrated FEL system components for power scaling. A 10 kilowatt laboratory demonstrator was used as a test bed. Demonstrated a separate photocathode test bed and refined photocathode models as a tools to design robust, long-life photocathodes. Investigated development of a separate injector test stand in conjunction with the photocathode test bed. Analyzed ship-board integration requirements. Conducted Service and Agency proposal call for FY 2005 and funded first year of selected efforts.			
(U)	In FY 2006: Develop and demonstrate technologies leading to a 100 kilowatt class demonstrator. Develop end-to-end simulation to develop refined system level technology for power scaling. Continue analysis of shipboard			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603924F High Energy Laser Advanced Technology Program	PROJECT NUMBER AND TITLE 5095 High Energy Laser Advanced Technology Program

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2005	FY 2006	FY 2007
	integration requirements. Conduct an industry proposal call for FY 2006, fund first year of selected efforts, and fund second year of FY 2005 Service and Agency efforts.			
(U)	In FY 2007: Examine all system components including compact electron beam lines, optical beam handling outside the laser, shipboard thermal management systems, and compact electrical power conditioning systems. Continue to fund the contract efforts started in FY 2006, conduct Service and Agency proposal call for FY 2007, and fund first year of selected efforts.			
(U)				
(U)	MAJOR THRUST: Develop chemical laser advanced technologies and concepts that allow higher performance and more supportable chemical lasers. Note: Work in this thrust will be completed in FY 2005.	0.387	0.000	0.000
(U)	In FY 2005: Demonstrated chemical laser generators that are capable of operating in a gravity free environment.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	9.490	5.713	3.713

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0602890F, High Energy Laser Research.									
(U) PE 0603444F, Maui Space Surveillance System.									
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.									
(U) PE 0603605F, Advanced Weapons Technology.									
(U) PE 0601108F, High Energy Laser Research Initiatives.									
(U) PE 0603883C, Ballistic Missile									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603924F High Energy Laser Advanced Technology Program**	PROJECT NUMBER AND TITLE **5095 High Energy Laser Advanced Technology Program**

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

Defense Boost Phase Segment.

(U) PE 0602605F, Directed Energy Technology.

(U) PE 0602307A, Advanced Weapons Technology.

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

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

(U) D. Acquisition Strategy

Not Applicable.

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PE NUMBER: 0207423F
PE TITLE: Advanced Communications Systems

Exhibit R-2, RDT&E Budget Item Justification	DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0207423F Advanced Communications Systems

	Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	14.767	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5084	AJCN	13.767	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5227	STEEL EAGLE	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

(U) A. Mission Description and Budget Item Justification

The Adaptive Joint Command, Control, Communications and Computing, Intelligence, Surveillance and Reconnaissance [C4ISR] Node (AJCN), Advanced Concept Technology Demonstration (ACTD) is developing software programmable Radio Frequency (RF) payloads designed to support Information Superiority. AJCN is an open, Commercial-Off-The-Shelf (COTS) based system that can be remotely programmed on the fly to perform a variety of functions simultaneously: air-to-air communications interoperability, Electronic Warfare (EW), Signals Intelligence (SIGINT), and Information Operations (IO). AJCN addresses numerous Mission Needs Statements (MNS), Operational Requirements Documents (ORD), and the Combatant Commanders Integrated Priority Lists (IPL) related to communications, intelligence and information operations.

Steel Eagle will replace the aging Silver Bullet capability that provides a transportable command, control and communications capability to the Secretary and Deputy Secretary of Defense, Chairman of the Joint Chiefs of Staff, Combatant Commanders, and other Senior Leaders aboard modified USAF cargo aircraft (KC-10s and C-17s, which have already been configured to accept the modules and are not part of this supplemental). FY05 supplemental funding will be used to pay for the design and fabrication of two (2) complete sets of Steel Eagle modules (a communications module and a conferencing module); a small system integration lab (SIL); procurement, installation, integration and testing of all C3 equipment (secure and non-secure voice, data, and video teleconferencing); support/office equipment and environmental equipment to operate the modules in the aircraft or as stand-alone C3 centers for initial support of the Senior Leader in theater. The aging, existing modules are commercial AirStream trailers, which consist of an executive suite and a communications suite.

This program is in Budget Activity 3, Advanced Component Development and Prototypes, because it involves demonstrating and evaluating integrated technologies in a realistic operating environment to assess the performance and/or cost reduction potential of advanced technology.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0207423F Advanced Communications Systems

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	11.860	0.000	0.000
(U)	Current PBR/President's Budget	14.767	0.000	0.000
(U)	Total Adjustments	2.907	0.000	
(U)	Congressional Program Reductions			
	Congressional Rescissions			
	Congressional Increases	1.000		
	Reprogrammings	1.907		
	SBIR/STTR Transfer			

(U) Significant Program Changes:

FY05 Supplemental for Global War on Terrorism increased Steel Eagle by $1M

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2006**

BUDGET ACTIVITY: **03 Advanced Technology Development (ATD)**

PE NUMBER AND TITLE: **0207423F Advanced Communications Systems**

PROJECT NUMBER AND TITLE: **5084 AJCN**

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5084 AJCN	13.767	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

The Adaptive Joint Command, Control, Communications and Computing, Intelligence, Surveillance and Reconnaissance (C4ISR) Node (AJCN), Advanced Concept Technology Demonstration (ACTD) is developing software programmable Radio Frequency (RF) payloads designed to support Information Superiority. AJCN is an open, Commercial-Off-The-Shelf (COTS) based system that can be remotely programmed on the fly to perform a variety of functions simultaneously: assure air-to-air communication interoperability, Electronic Warfare (EW), Signals Intelligence (SIGINT), and Information Operations (IO). AJCN addresses numerous Mission Needs Statements (MNS), Operational Requirements Documents (ORD), and the Combatant Commanders Integrated Priority Lists (IPL) related to communications, intelligence and Information Operations (IO).

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies to enhance Air Force operational systems. FY06 funding has been moved to BPAC 645084 to complete is ACTD project

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) System Engineering and Integration	10.443		
(U) Field Evaluation/Military Utitlity Assessment	2.693		0.000
(U) Concept of Operations (CONOPS)/TTP Development and Test	0.631		
(U) Total Cost	13.767	0.000	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) N/A									

(U) D. Acquisition Strategy

All major contracts within this Program Element and programs were awarded after full and open competition.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0207423F Advanced Communications Systems	PROJECT NUMBER AND TITLE: 5227 STEEL EAGLE

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5227 STEEL EAGLE	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

Steel Eagle will replace the aging Silver Bullet capability that provides a transportable command, control and communications capability to the Secretary and Deputy Secretary of Defense, Chairman of the Joint Chiefs of Staff, Combatant Commanders, and other Senior Leaders aboard modified USAF cargo aircraft (KC-10s and C-17s, which have already been configured to accept the modules and are not part of this supplemental). FY05 supplemental funding will be used to pay for the design and fabrication of two (2) complete sets of Steel Eagle modules (a communications module and a conferencing module); a small system integration lab (SIL); procurement, installation, integration and testing of all C3 equipment (secure and non-secure voice, data, and video teleconferencing); support/office equipment and environmental equipment to operate the modules in the aircraft or as stand-alone C3 centers for initial support of the Senior Leader in theater. The aging, existing modules are commercial AirStream trailers, which consist of an executive suite and a communications suite.

The advent of the Global War of Terrorism, OIF and OEF has necessitated a substantial increase in the frequency and duration of overseas travel by Senior Leaders in general and in particular to/from and within the CENTCOM AOR. In addition, these events have simultaneously necessitated a substantial increase in C3 capabilities required for Senior Leaders to execute their duties while in transit to and from the CENTCOM AOR and other overseas locations and while at trip sites within the CENTCOM AOR and other locations When Senior Leaders, including the Secretary and Deputy Secretary of Defense, Chairman of the Joint Chiefs of Staff, Senior White House and Defense Department officials, various Unified Combatant Commanders, and others travel to or within the CENTCOM AOR (high risk areas or other areas where it is inappropriate or unadvisable to be highly visible in an official USAF Special Air Mission (SAM) aircraft (e.g., C-32A, C-40B)), they will travel in one of the specially modified KC-10s or C-17s with a Silver Bullet module onboard to provide C3 support while in transit and while on the ground at trip sites. The Silver Bullet modules are beyond their expected useful life and are physically wearing out.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) Silver Bullet development	0.650		
(U) System integration	0.250		
(U) Interoperational test planning	0.100		
(U) Total Cost	1.000	0.000	0.000

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) N/A									

(U) D. Acquisition Strategy

All major contracts within this Program Element and programs were awarded after full and open competition.

PE NUMBER: 0401840F
PE TITLE: AMC COMMAND & CONTROL SYSTEM

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0401840F AMC COMMAND & CONTROL SYSTEM

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	5.803	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5085 Agile Transportation	5.803	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

In FY04, this is a new PE.

(U) A. Mission Description and Budget Item Justification

Agile Transportation for the 21st Century (AT21) Advanced Concept Technology Development (ACTD) provides for a suite of decision support tools capitalizing on emerging technology to enhance command and control of the Defense Transportation System (DTS). In concert with Joint Vision 2020, AT21 will focus on identifying, exploring, and fostering advanced synergistic technologies for transportation and sustainment processes with an 'end-to-end' systems perspective. AT21 will transition both COTS and GOTS maturing database, optimization and collaboration technologies into the Defense Transportation System (DTS) to improve peacetime and wartine transportation operations for all Combatant Commanders, Services, and governmental entities. Transportation mode determination and optimization for strategic lift will be based on objective, time-sensitive delivery criteria. The United States Transportation Command (USTRANSCOM) will have the ability to provide the supported CINC with modal alternatives to meet such deployment requirements as required delivery date in theater. Assignment to sealift of collaboratively selected, sealift-qualified, movement requirements will automatically increase availability of scarce airlift assets for assignment to true mission critical requirements. AT21 will produce a software toolsuite for synchronizing and optimizing all DTS operations through unit level execution. This effort will produce an immediate return on investment through better lift aggregation, cost avoidance by increased lift optimization and quality of life of the service members, due to better scheduling. Additionally, this effort will support the Combatant Commanders with improved, rapid, and collaborative transportation planning to support any force deployment.

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates cost-effective technologies to improve the design, performance, and support of current and future weapon systems.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	5.985	0.000	0.000
(U)	Current PBR/President's Budget	5.803	0.000	0.000
(U)	Total Adjustments	-0.182	0.000	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.182		
	Congressional Increases			
	Reprogrammings			
	SBIR/STTR Transfer			
(U)	Significant Program Changes:			

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0401840F AMC COMMAND & CONTROL SYSTEM	PROJECT NUMBER AND TITLE: 5085 Agile Transportation

Cost ($ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5085 Agile Transportation	5.803	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

Agile Transportation for the 21st Century (AT21) Advanced Concept Technology Development (ACTD) provides for a suite of decision support tools capitalizing on emerging technology to enhance command and control of the Defense Transportation System (DTS). In concert with Joint Vision 2020, AT21 will focus on identifying, exploring, and fostering advanced synergistic technologies for transportation and sustainment processes with an 'end-to-end' systems perspective. AT21 will transition both COTS and GOTS maturing database, optimization and collaboration technologies into the Defense Transportation System (DTS) to improve peacetime and wartine transportation operations for all Combatant Commanders, Services, and governmental entities. Transportation mode determination and optimization for strategic lift will be based on objective, time-sensitive delivery criteria. The United States Transportation Command (USTRANSCOM) will have the ability to provide the supported CINC with modal alternatives to meet such deployment requirements as required delivery date in theater. Assignment to sealift of collaboratively selected, sealift-qualified, movement requirements will automatically increase availability of scarce airlift assets for assignment to true mission critical requirements. AT21 will produce a software toolsuite for synchronizing and optimizing all DTS operations through unit level execution. This effort will produce an immediate return on investment through better lift aggregation, cost avoidance by increased lift optimization and quality of life of the service members, due to better scheduling. Additionally, this effort will support the Combatant Commanders with improved, rapid, and collaborative transportation planning to support any force deployment.

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates cost-effective technologies to improve the design, performance, and support of current and future weapon systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) Continue development of Strategic Transportation Planner (STP) to support optimization, mode determination broker and schedular.	1.500		
(U) Continue development of Aircrew Scheduler, Airbase Tactical Transportation Planner, and Aircraft Maintenance Schedular to support the tactical echelon for optimization of assets.	1.685		
(U) Continue development of deep Collaboration in phases with Air Mobility Command (AMC), Military Traffic Mobility Command (MTMC), Military Sealift Command (MSC), Joint Forces Command (JFCOM), Pacific command (PACOM), and Central Command (CENTCOM).	0.800		
(U) Continue development of AMC Operational Transportation Planner to support the operational echelon for optimization of assets, mode determination and schedular.	1.818		
(U) Total Cost	5.803	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0401840F AMC COMMAND & CONTROL SYSTEM	PROJECT NUMBER AND TITLE 5085 Agile Transportation

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

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 063750D8Z, DUSD (AS&C)									
(U) PE 0603728D8Z, DUSD (S&T)									
(U) PE 0604764K, DISA (AITS/JPO)									
(U) PE 41119F									
(U) PE 41115F									
(U) PE 0603772A (USA)									

(U) D. Acquisition Strategy

Use spiral development, obtaining Indefinite Delivery and Indefinite Quantity contracts.

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