DEPARTMENT OF THE AIR FORCE

FISCAL YEAR (FY) 2008/2009 BUDGET ESTIMATES

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

DESCRIPTIVE SUMMARIES, VOLUME I

SCIENTIFIC AND TECHNOLOGY BUDGET ACTIVITIES 1 - 3

FEBRUARY 2007

Fiscal Year 2008/2009 Budget Estimates
RDT&E Descriptive Summaries, Volume I
Scientific and Technology Budget Activities 1 - 3
February 2007

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 2008 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 2008 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) There are no "Facilities Exhibits", Military Construction Project Data, (DD 1391), for improvements to and construction of government-owned facilities funded in RD&E, included in this submission.

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.

TABLE OF CONTENTS

TABLE OF CONTENTS Continued

#3 - Advanced Technology Development (ATD) Continued

TABLE OF CONTENTS Continued

TABLE OF CONTENTS Continued

#5 - System Development and Demonstration (SDD) Continued

TABLE OF CONTENTS Continued

TABLE OF CONTENTS Continued

#6 - RDT&E Management Support Continued

#7 - Operational System Development

TABLE OF CONTENTS Continued

#7 - Operational System Development Continued

TABLE OF CONTENTS Continued

#7 - Operational System Development Continued

TABLE OF CONTENTS Continued

#7 - Operational System Development Continued

TABLE OF CONTENTS Continued

#7 - Operational System Development Continued

ALPHABETICAL LISTING

DEPARTMENT OF DEFENSE

FY 2008 RDT&E PROGRAM

SUMMARY
($ IN THOUSANDS)

22 JAN 2007

APPROPRIATION	FY 2006	FY 2007	FY 2008
Research, Development, Test & Eval, AF	22,190,943	24,420,623	26,711,940
Total Research, Development, Test & Evaluation	22,190,943	24,420,623	26,711,940

DEPARTMENT OF DEFENSE

FY 2008 RDT&E PROGRAM

SUMMARY
($ IN THOUSANDS)

22 JAN 2007

Summary Recap of Budget Activities	FY 2006	FY 2007	FY 2008
Basic Research	374,335	408,547	375,199
Applied Research	1,039,305	1,155,523	1,011,075
Advanced Technology Development	974,770	1,037,521	577,266
Advanced Component Development & Prototypes	2,178,587	2,539,678	2,938,712
System Development & Demonstration	4,592,979	4,671,927	4,319,233
RDT&E Management Support	1,376,255	1,060,430	1,054,328
Operational Systems Development	11,654,712	13,546,997	16,436,127
Total Research, Development, Test & Evaluation	22,190,943	24,420,623	26,711,940

Summary Recap of FYDP Programs	FY 2006	FY 2007	FY 2008
Strategic Forces	109,692	201,421	136,178
General Purpose Forces	3,352,770	3,949,267	3,666,904
Intelligence and Communications	8,218,167	9,315,800	11,970,886
Mobility Forces	757,616	777,078	1,096,094
Research and Development	9,575,886	9,875,249	9,561,730
Central Supply and Maintenance	127,353	240,089	188,985
Training Medical and Other	3,216	3,467	3,243
Administration and Associated Activities	42,661	54,356	83,879
Support of Other Nations	3,582	3,896	4,041
Total Research, Development, Test & Evaluation	22,190,943	24,420,623	26,711,940

DEPARTMENT OF THE AIR FORCE

FY 2008 RDT&E PROGRAM

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($ IN THOUSANDS)

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DEPARTMENT OF THE AIR FORCE
FY 2008 RDT&E PROGRAM

EXHIBIT R-1

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

Date: 22 JAN 2007

Line No	Program Element Number	Item	Act	FY 2006 (Thousands of Dollars)	FY 2007 (Thousands of Dollars)	FY 2008 (Thousands of Dollars)	SEC
1	0601102F	Defense Research Sciences	01	256,565	281,156	258,259	U
2	0601103F	University Research Initiatives	01	105,698	115,035	104,304	U
3	0601108F	High Energy Laser Research Initiatives	01	12,072	12,356	12,636	U
	Basic Research			374,335	408,547	375,199	
4	0602015F	Medical Development	02		23,810		U
5	0602102F	Materials	02	114,877	153,293	122,794	U
6	0602201F	Aerospace Vehicle Technologies	02	102,792	118,901	131,948	U
7	0602202F	Human Effectiveness Applied Research	02	111,369	109,174	79,856	U
8	0602203F	Aerospace Propulsion	02	153,760	218,657	179,161	U
9	0602204F	Aerospace Sensors	02	114,934	133,235	108,055	U
10	0602500F	Multi-disciplinary Space Technology	02	89,761			U
11	0602601F	Space Technology	02	103,604	103,472	109,566	U
12	0602602F	Conventional Munitions	02	58,012	61,868	57,804	U
13	0602605F	Directed Energy Technology	02	43,287	50,019	54,883	U
14	0602702F	Command Control and Communications	02	95,676	128,680	116,705	U
15	0602805F	Dual Use Science and Technology Program	02	962			U
16	0602890F	High Energy Laser Research	02	50,271	52,136	50,303	U
17	0207170F	Joint Helmet Mounted Cueing System (JHMCS)	02		2,278		U
18	0301555F	Classified Programs	02				
19	0301556F	Special Program	02				
	Applied Research			1,039,305	1,155,523	1,011,075	

DEPARTMENT OF THE AIR FORCE
FY 2008 RDT&E PROGRAM

EXHIBIT R-1

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

Date: 22 JAN 2007

Line No	Program Element Number	Item	Act	FY 2006 (Thousands of Dollars)	FY 2007 (Thousands of Dollars)	FY 2008 (Thousands of Dollars)	SEC
20	0603112F	Advanced Materials for Weapon Systems	03	65,193	82,290	39,730	U
21	0603203F	Advanced Aerospace Sensors	03	38,471	58,228	55,549	U
22	0603211F	Aerospace Technology Dev/Demo	03	38,753	36,286	64,922	U
23	0603216F	Aerospace Propulsion and Power Technology	03	98,901	145,891	117,990	U
24	0603231F	Crew Systems and Personnel Protection Technology	03	33,570	43,890	28,558	U
25	0603270F	Electronic Combat Technology	03	32,247	28,528	23,743	U
26	0603311F	Ballistic Missile Technology	03	11,146	9,365		U
27	0603400F	Joint Unmanned Combat Air Systems (J-UCAS) Advanced Technology Dev and Research	03	80,362			U
28	0603401F	Advanced Spacecraft Technology	03	86,327	101,115	78,704	U
29	0603422F	Global Positioning System (GPS) Extension Program	03			70,758	U
30	0603444F	Maui Space Surveillance System (MSSS)	03	45,943	50,383	5,237	U
31	0603500F	Multi-disciplinary Advanced Development Space Technology	03	51,929			U
32	0603601F	Conventional Weapons Technology	03	35,916	38,530	16,904	U
33	0603605F	Advanced Weapons Technology	03	42,124	76,733	43,999	U
34	0603789F	C3I Advanced Development	03	41,345	48,195	27,357	U
35	0603801F	Special Programs	03	266,984	314,384		U
36	0603924F	High Energy Laser Advanced Technology Program	03	5,559	3,699	3,815	U
37	0207418F	Tactical Airborne Control Systems	03		4		U
38	0301555F	Classified Programs	03				

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39	0301556F	Special Program	03				
		Advanced Technology Development		974,770	1,037,521	577,266	
40	0603260F	Intelligence Advanced Development	04	4,759	4,763	4,930	U
41	0603287F	Physical Security Equipment	04	24,858	1,284	466	U
42	0603421F	NAVSTAR Global Positioning System III	04	89,556	313,401	587,226	U
43	0603430F	Advanced EHF MILSATCOM (SPACE)	04	639,179	630,868	603,179	U
44	0603432F	Polar MILSATCOM (SPACE)	04	6,028	35,470	178,754	U
45	0603438F	Space Control Technology	04	14,598	30,107	37,604	U
46	0603742F	Combat Identification Technology	04	49,569	26,407	26,054	U
47	0603790F	NATO Research and Development	04	3,842	4,080	4,280	U
48	0603791F	International Space Cooperative R&D	04	550	591	619	U
49	0603845F	Transformational SATCOM (TSAT)	04	416,813	729,945	963,585	U
50	0603850F	Integrated Broadcast Service	04	15,930	20,471	21,192	U
51	0603851F	Intercontinental Ballistic Missile	04	56,773	60,907	26,519	U
52	0603854F	Wideband Gapfiller System RDT&E (Space)	04	97,718	37,530	19,213	U
53	0603858F	Space Radar	04	98,062	185,399		U
54	0603859F	Pollution Prevention	04	10,188	7,026	2,838	U
55	0603860F	Joint Precision Approach and Landing Systems	04	6,068	9,908	7,544	U
56	0604015F	Next Generation Bomber	04	24,108	25,491		U
57	0604327F	Hard and Deeply Buried Target Defeat System (HDBTDS) Program	04	3,854			U

DEPARTMENT OF THE AIR FORCE
FY 2008 RDT&E PROGRAM

EXHIBIT R-1

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Line No	Program Element Number	Item	Act	FY 2006 (Thousands of Dollars)	FY 2007 (Thousands of Dollars)	FY 2008 (Thousands of Dollars)	SEC
58	0604400F	Joint Unmanned Combat Air Systems (J-UCAS) Advanced Component and Prototype Deve	04	222,540			U
59	0604855F	Operationally Responsive Launch	04	45,155			U
60	0604856F	Common Aero Vehicle (CAV)	04	26,548	33,185	32,806	U
61	0604857F	Operationally Responsive Space	04		35,411	87,032	U
62	0207423F	Advanced Communications Systems	04	3,316			U
63	0305178F	National Polar-Orbiting Operational Environmental Satellite System (NPOESS)	04	318,575	347,434	334,871	U
		Advanced Component Development & Prototypes		2,178,587	2,539,678	2,938,712	
64	0603840F	Global Broadcast Service (GBS)	05	18,648	24,749	29,407	U
65	0604012F	Joint Helmet Mounted Cueing System (JHMCS)	05	3,590	2,781		U
66	0604222F	Nuclear Weapons Support	05	13,952	14,839	20,319	U
67	0604226F	B-1B	05	76,496	130,053	159,126	U
68	0604233F	Specialized Undergraduate Flight Training	05	9,832	3,689	12,622	U
69	0604239F	F-22	05	71,818			U
70	0604240F	B-2 Advanced Technology Bomber	05	281,671	241,608	244,019	U
71	0604261F	Personnel Recovery Systems	05		200,695	290,059	U
72	0604270F	Electronic Warfare Development	05	97,122	92,832	101,649	U
73	0604280F	Joint Tactical Radio	05	77,130			U
74	0604287F	Physical Security Equipment	05	10,685	93	34	U
75	0604329F	Small Diameter Bomb (SDB)	05	64,474	105,481	145,191	U
76	0604421F	Counterspace Systems	05	28,203	50,253	53,412	U

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77	0604425F	Space Situation Awareness Systems	05		121,696	187,804	U
78	0604429F	Airborne Electronic Attack	05	29,833	12,374	20,007	U
79	0604441F	Space Based Infrared System (SBIRS) High EMD	05	706,560	664,880	587,004	U
80	0604443F	Alternative Infrared Space System (AIRSS)	05		67,552	230,887	U
81	0604600F	Munitions Dispenser Development	05	14,472			U
82	0604602F	Armament/Ordnance Development	05	7,613	5,020	1,985	U
83	0604604F	Submunitions	05	5,368	8,327	1,988	U
84	0604617F	Agile Combat Support	05	11,045	10,056	10,623	U
85	0604618F	Joint Direct Attack Munition	05		15,392		U
86	0604706F	Life Support Systems	05	12,047	14,216	12,649	U
87	0604735F	Combat Training Ranges	05	8,336	16,700	17,657	U
88	0604740F	Integrated Command & Control Applications (IC2A)	05	27,976	23,664	189	U
89	0604750F	Intelligence Equipment	05	2,728	4,907	1,469	U
90	0604762F	Common Low Observables Verification System (CLOVerS)	05	12,737	4,483		U
91	0604800F	Joint Strike Fighter (JSF)	05	2,264,836	2,132,924	1,780,874	U
92	0604851F	Intercontinental Ballistic Missile	05	30,952			U
93	0604853F	Evolved Expendable Launch Vehicle Program (SPACE)	05	19,050	19,738		U
94	0605011F	RDT&E for Aging Aircraft	05	37,404	26,490	17,021	U
95	0605807F	Test and Evaluation Support	05			3,044	U
96	0207434F	Link-16 Support and Sustainment	05	156,851	173,216	199,363	U

DEPARTMENT OF THE AIR FORCE
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Line No	Program Element Number	Item	Act	FY 2006 (Thousands of Dollars)	FY 2007 (Thousands of Dollars)	FY 2008 (Thousands of Dollars)	SEC
97	0207443F	Family of Interoperable Operational Pictures (FIOP)	05	35,067			U
98	0207450F	E-10 Squadrons	05	378,871	366,012	39,703	U
99	0207451F	Single Integrated Air Picture (SIAP)	05		39,973	4,976	U
100	0207701F	Full Combat Mission Training	05	25,723	35,010	87,096	U
101	0305176F	Combat Survivor Evader Locator	05	16,817			U
102	0401138F	Joint Cargo Aircraft (JCA)	05	1,400	15,723	42,368	U
103	0401318F	CV-22	05	33,672	26,501	16,688	U
		System Development & Demonstration		4,592,979	4,671,927	4,319,233	
104	0604256F	Threat Simulator Development	06	31,387	37,987	39,892	U
105	0604759F	Major T&E Investment	06	62,753	61,671	59,064	U
106	0605101F	RAND Project Air Force	06	33,098	26,510	30,999	U
107	0605306F	Ranch Hand II Epidemiology Study	06	4,024			U
108	0605502F	Small Business Innovation Research	06	339,887			U
109	0605712F	Initial Operational Test & Evaluation	06	28,184	34,670	30,203	U
110	0605807F	Test and Evaluation Support	06	701,064	739,708	737,558	U
111	0605860F	Rocket Systems Launch Program (SPACE)	06	25,365	26,005	15,145	U
112	0605864F	Space Test Program (STP)	06	49,315	46,135	47,430	U
113	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support	06	65,494	55,472	59,131	U
114	0605978F	Facilities Sustainment - Test and Evaluation Support	06	31,697	28,072	30,865	U
115	0804731F	General Skill Training	06	309	304		U

DEPARTMENT OF THE AIR FORCE
FY 2008 RDT&E PROGRAM

EXHIBIT R-1

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Date: 22 JAN 2007

Line No	Program Element Number	Item	Act	FY 2006 (Thousands of Dollars)	FY 2007 (Thousands of Dollars)	FY 2008 (Thousands of Dollars)	SEC
116	0909999F	Financing for Cancelled Account Adjustments	06	96			U
117	1001004F	International Activities	06	3,582	3,896	4,041	U
		RDT&E Management Support		1,376,255	1,060,430	1,054,328	
118	0605024F	Anti-Tamper Technology Executive Agency	07	10,029	7,984	10,930	U
119	0605798F	Analysis Support Group	07				
120	0101113F	B-52 Squadrons	07	23,071	75,991	41,916	U
121	0101120F	Advanced Cruise Missile	07	2,712	6,957		U
122	0101122F	Air-Launched Cruise Missile (ALCM)	07	3,050	3,722	4,672	U
123	0101313F	Strat War Planning System - USSTRATCOM	07	28,869	28,577	20,340	U
124	0101314F	Night Fist - USSTRATCOM	07	4,803	5,107	5,296	U
125	0101815F	Advanced Strategic Programs	07				
126	0102326F	Region/Sector Operation Control Center Modernization Program	07	22,453	14,744	23,495	U
127	0203761F	Warfighter Rapid Acquisition Process (WRAP) Rapid Transition Fund	07	22,130	30,469	14,245	U
128	0205219F	MQ-9 UAV	07			61,069	U
129	0207131F	A-10 Squadrons	07	55,713	31,850	1,963	U
130	0207133F	F-16 Squadrons	07	124,482	151,997	90,620	U
131	0207134F	F-15E Squadrons	07	135,009	137,541	101,251	U
132	0207136F	Manned Destructive Suppression	07	7,229	513		U
133	0207138F	F-22A Squadrons	07	341,789	472,475	743,593	U
134	0207141F	F-117A Squadrons	07	11,349	14,040		U

DEPARTMENT OF THE AIR FORCE
FY 2008 RDT&E PROGRAM

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

Date: 22 JAN 2007

Line No	Program Element Number	Item	Act	FY 2006	FY 2007	FY 2008	SEC
135	0207161F	Tactical AIM Missiles	07	14,974	8,817	7,927	U
136	0207163F	Advanced Medium Range Air-to-Air Missile (AMRAAM)	07	31,803	43,253	36,838	U
137	0207170F	Joint Helmet Mounted Cueing System (JHMCS)	07			5,338	U
138	0207224F	Combat Rescue and Recovery	07	50,672			U
139	0207247F	AF TENCAP	07	11,660	11,160	11,526	U
140	0207248F	Special Evaluation Program	07	286,451	527,588		U
141	0207253F	Compass Call	07	9,598	9,931	4,603	U
142	0207268F	Aircraft Engine Component Improvement Program	07	146,527	153,736	139,042	U
143	0207277F	CSAF Innovation Program	07	1,626	1,587		U
144	0207325F	Joint Air-to-Surface Standoff Missile (JASSM)	07	58,820	40,727	12,152	U
145	0207410F	Air & Space Operations Center (AOC)	07	51,796	76,849	111,557	U
146	0207412F	Control and Reporting Center (CRC)	07	26,746	8,743	16,505	U
147	0207417F	Airborne Warning and Control System (AWACS)	07	129,334	164,982	152,721	U
148	0207418F	Tactical Airborne Control Systems	07		2,303	3,387	U
149	0207423F	Advanced Communications Systems	07	22,166	42,905	33,584	U
150	0207424F	Evaluation and Analysis Program	07	5,992	2,590	650,608	U
151	0207433F	Advanced Program Technology	07	287,311	311,932		U
152	0207438F	Theater Battle Management (TBM) C4I	07	54,085	31,701	9,961	U
153	0207445F	Fighter Tactical Data Link	07	115,818	112,755	39,545	U
154	0207446F	Bomber Tactical Data Link	07	133,836	100,744	37,130	U

DEPARTMENT OF THE AIR FORCE
FY 2008 RDT&E PROGRAM

EXHIBIT R-1

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

Date: 22 JAN 2007

Line No	Program Element Number	Item	Act	FY 2006	FY 2007	FY 2008	SEC
155	0207448F	C2ISR Tactical Data Link	07	14,219	4,322	1,809	U
156	0207449F	Command and Control (C2) Constellation	07	39,123	43,686	45,049	U
157	0207581F	Joint Surveillance/Target Attack Radar System (JSTARS)	07	110,852	155,615	65,924	U
158	0207590F	Seek Eagle	07	19,108	16,364	22,969	U
159	0207591F	Advanced Program Evaluation	07	269,037	435,328		U
160	0207601F	USAF Modeling and Simulation	07	24,303	23,670	23,044	U
161	0207605F	Wargaming and Simulation Centers	07	6,087	6,570	6,490	U
162	0207697F	Distributed Training and Exercises	07	4,045	6,115	7,522	U
163	0208006F	Mission Planning Systems	07	115,002	129,259	105,371	U
164	0208021F	Information Warfare Support	07	14,250	20,657	12,111	U
165	0208161F	Special Evaluation System	07			760,312	U
166	0301310F	National Air Intelligence Center	07				
167	0301314F	COBRA BALL	07				
168	0301315F	Missile and Space Technical Collection	07				
169	0301324F	FOREST GREEN	07				
170	0301386F	GDIP Collection Management	07				
171	0302015F	E-4B National Airborne Operations Center (NAOC)	07	14,281	282	19,529	U
172	0303112F	Air Force Communications (AIRCOM)	07			2,022	U
173	0303131F	Minimum Essential Emergency Communications Network (MEECN)	07	48,234	63,765	103,846	U
174	0303140F	Information Systems Security Program	07	103,288	184,610	229,657	U

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

Date: 22 JAN 2007

Line No	Program Element Number	Item	Act	FY 2006 (Thousands of Dollars)	FY 2007 (Thousands of Dollars)	FY 2008 (Thousands of Dollars)	SEC
175	0303141F	Global Combat Support System	07	22,696	19,820	10,631	U
176	0303150F	Global Command and Control System	07	3,358	3,290	3,397	U
177	0303158F	Joint Command and Control Program (JC2)	07	4,982	5,768	5,841	U
178	0303601F	MILSATCOM Terminals	07	254,052	269,926	388,491	U
179	0304111F	Special Activities	07				
180	0304260F	Airborne SIGINT Enterprise	07	87,762	117,390	139,627	U
181	0304311F	Selected Activities	07				
182	0304348F	Advanced Geospatial Intelligence (AGI)	07				
183	0305099F	Global Air Traffic Management (GATM)	07	6,760	6,595	6,681	U
184	0305110F	Satellite Control Network (SPACE)	07	24,609	19,783	27,256	U
185	0305111F	Weather Service	07	27,505	35,701	39,747	U
186	0305114F	Air Traffic Control, Approach, and Landing System (ATCALS)	07	5,908	3,467	4,672	U
187	0305116F	Aerial Targets	07	5,388	5,183	7,376	U
188	0305124F	Special Applications Program	07				
189	0305127F	Foreign Counterintelligence Activities	07				
190	0305128F	Security and Investigative Activities	07	470	507	829	U
191	0305142F	Applied Technology and Integration	07				
192	0305159F	Defense Reconnaissance Support Activities (SPACE)	07				
193	0305160F	Defense Meteorological Satellite Program (SPACE)	07	3,749	963		U

DEPARTMENT OF THE AIR FORCE
FY 2008 RDT&E PROGRAM

EXHIBIT R-1

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

Date: 22 JAN 2007

Line No	Program Element Number	Item	Act	FY 2006	FY 2007	FY 2008	SEC
194	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	07	111,710	133,574	93,267	U
195	0305165F	NAVSTAR Global Positioning System (Space and Control Segments)	07	174,530	176,721	120,931	U
196	0305172F	Combined Advanced Applications	07				
197	0305173F	Space and Missile Test and Evaluation Center	07		4,657	3,089	U
198	0305174F	Space Warfare Center	07	383	723	1,678	U
199	0305182F	Spacelift Range System (SPACE)	07	49,515	38,509	27,300	U
200	0305193F	Intelligence Support to Information Operations (IO)	07	3,566	3,785	1,134	U
201	0305202F	Dragon U-2	07	10,012			U
202	0305206F	Airborne Reconnaissance Systems	07	55,711	52,624	64,869	U
203	0305207F	Manned Reconnaissance Systems	07	18,074	16,669	12,672	U
204	0305208F	Distributed Common Ground/Surface Systems	07	36,550	125,267	107,117	U
205	0305219F	MQ-1 Predator A UAV	07	54,100	67,885	22,296	U
206	0305220F	Global Hawk UAV	07	257,687	247,726	298,501	U
207	0305221F	Network-Centric Collaborative Targeting	07	8,508	8,467	8,641	U
208	0305887F	Intelligence Support to Information Warfare	07	944	5,144	5,362	U
209	0305906F	NCMC - TW/AA System	07	55,306	43,271	11,882	U
210	0305910F	SPACETRACK (SPACE)	07	182,779			U
211	0305913F	NUDET Detection System (SPACE)	07	32,265	59,917	38,974	U
212	0305917F	Space Architect	07	12,331			U
213	0305924F	National Security Space Office	07		13,365	10,821	U

Thousands of Dollars

DEPARTMENT OF THE AIR FORCE
FY 2008 RDT&E PROGRAM

EXHIBIT R-1

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

Date: 22 JAN 2007

Line No	Program Element Number	Item	Act	FY 2006	FY 2007	FY 2008	SEC
214	0305940F	Space Situation Awareness Operations	07		31,282	23,980	U
215	0307141F	NASS, IO Technology Integration & Tool Dev	07	14,507	15,391	15,681	U
216	0308699F	Shared Early Warning (SEW)	07	2,959	2,975	3,152	U
217	0401115F	C-130 Airlift Squadron	07	232,342	230,709	188,069	U
218	0401119F	C-5 Airlift Squadrons (IF)	07	225,730	150,638	203,585	U
219	0401130F	C-17 Aircraft (IF)	07	160,608	173,125	181,734	U
220	0401132F	C-130J Program	07	11,401	40,389	74,223	U
221	0401133F	Aeromedical Evacuation	07	1,989			U
222	0401134F	Large Aircraft IR Countermeasures (LAIRCM)	07	49,951	40,463	19,324	U
223	0401218F	KC-135s	07	1,456	1,122	8,766	U
224	0401219F	KC-10s	07	12,907	4,763	36,790	U
225	0401221F	KC-135 Tanker Replacement	07	24,095	69,632	314,454	U
226	0401314F	Operational Support Airlift	07			4,868	U
227	0401839F	Air Mobility Tactical Data Link	07		22,000		U
228	0408011F	Special Tactics / Combat Control	07	2,065	2,013	5,225	U
229	0702207F	Depot Maintenance (Non-IF)	07	1,349	1,452	1,510	U
230	0702806F	Acquisition and Management Support	07	10,739	17,614	22,317	U
231	0708011F	Industrial Preparedness	07	56,683	66,122	39,906	U
232	0708012F	Logistics Support Activities	07	2,682	1,295		U
233	0708610F	Logistics Information Technology (LOGIT)	07	32,837	120,851	114,176	U
234	0708611F	Support Systems Development	07	23,063	32,755	11,076	U

Thousands of Dollars

DEPARTMENT OF THE AIR FORCE
FY 2008 RDT&E PROGRAM

EXHIBIT R-1

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

Date: 22 JAN 2007

Line No	Program Element Number	Item	Act	FY 2006 (Thousands of Dollars)	FY 2007 (Thousands of Dollars)	FY 2008 (Thousands of Dollars)	SEC
235	0804757F	Joint National Training Center	07	2,801	3,050	3,128	U
236	0808716F	Other Personnel Activities	07	106	113	115	U
237	0901202F	Joint Personnel Recovery Agency	07	931	988	5,377	U
238	0901212F	Service-Wide Support (Not Otherwise Accounted For)	07			6,495	U
239	0901218F	Civilian Compensation Program	07	13,759	7,750	8,070	U
240	0901220F	Personnel Administration	07	15,078	18,193	16,832	U
241	0901538F	Financial Management Information Systems Development	07	12,797	27,425	47,105	U
		Operational Systems Development		11,654,712	13,546,997	16,436,127	
		Total Research, Development, Test & Eval, AF		22,190,943	24,420,623	26,711,940	

PROGRAM ELEMENT COMPARISON SUMMARY

PROGRAM ELEMENT (By BUDGET ACTIVITY)

BUDGET ACTIVITY #1: BASIC RESEARCH (Volume 1)		REMARKS
0601102F	Defense Research Sciences	In FY 2008, Space environment effort from Project 2311 and physical mathematics effort from Project 2304 will be moved to this Project in FY 2008 to more accuratley align basic research efforts in Physics.
BUDGET ACTIVITY #2: APPLIED RESEARCH (Volume 1)		
0602605F	Directed Energy Technology	In FY 2008, relay mirror technology efforts in Project 55SP, Laser and Imaging Space Technology, will transfer to Project 4866, Lasers and Imaging Technology, within this PE in order to more effectively manage the efforts.
BUDGET ACTIVITY #3: ADVANCED TECHNOLOGY DEVELOPMENT (Volume 1)		
0603211F	Aerospace Technology Dev/Demo	In FY 2008, the remaining efforts in Project 6399SP were transferred into Project 4920 within this PE, as the planned efforts were not space unique.
0603216F	Aerospace Propulsion and Power Technology	In FY 2008, the funding in this PE has been increased in FY 2008 and out due to emphasis on component development in support of adaptive cycle demonstrations, highly efficient embedded turbine engines, and small heavy fueled engines.
0603605F	Advanced Weapons Technology	In FY 2008, funds for the FY 2006 Congressionally-directed Aerospace Relay Mirror System in the amount of $2.100 million were transferred to PE 0603605F, Advanced Weapons Technology, from PE 0603500F, Multi-Disciplinary Advanced Development, for execution. Also in FY 2008, this effort moves into Project 3151 in this program element.
BUDGET ACTIVITY #4: ADVANCED COMPONENT DEVELOPMENT AND PROTOTYPE (Volume 2)		
0603430F	Advanced (EHF MILSATCOM (Space))	In FY 2008, funds for qualification and productization of radiation-hardened components for USAF/DOD space programs have been transferred from PE 63430F, Advanced MILSATCOM (Space), to PE 63845F, Transformational SATCOM.
0603845F	Transformational SATCOM (TSAT)	In FY 2008, funds for qualification and productization of radiation-hardened components for USAF/DOD space programs have been transferred from PE 63430F, Advanced MILSATCOM (Space), to PE 63845F, Transformational SATCOM.
0603851F	ICBM - DEM/VAL	In FY 2008 and beyond, Project 1024 ICBM Command & Control (C2) Applications is discontinued.
BUDGET ACTIVITY #5: SYSTEM DEVELOPMENT AND DEMONSTRATION (SDD) (Volume 2)		

0207434F	Link 16 Support and Sustainment	In FY 2008, Project 655262 was established to consolidate gateway efforts within the Link 16 Support & Sustainment program element. Beginning in FY08, all TDL funding for gateway programs moved from Project 655050 to new Project 655262, Family of Gateways.
0207701F	Full Combat Mission Training	In FY 2008, funding previously documented in BPAC 4673 is consolidated in BPAC 5012
0401138F	Joint Cargo Aircraft	In FY 2008, FY10-FY13: Final AF JCA requirements and procurement quantities are still being defined. These requirements will be validated by early FY08. The AF intends to transfer a portion of APAF funds to RDT&E in the FY10 POM to support any resulting aircraft, training system, test, and support system development requirements that remain.
0604261F	Personnel Recovery Systems	In FY 2008, Project Number 5249, HC-130 Recap, includes new start efforts. Procurement funding for CSAR-X and HC-130 Recap remains in PE 0207224F and is reported in P-Docs.
0604425F	Space Situation Awareness Systems	In FY 2008, this project 65A008 was renamed from Space Situation Awareness Initiatives to its present name.
0604602F	Armament/Ordnance Development	In FY 2008, moved all funds and activities from the other 2 project to project 3133 Armament Subsystems (new name, old name was Bombs & Fuzes). This is done to consolidate and simplify the program element.
0604604F	Submunitions	In FY 2008, for this PE, the T&E funding alignment begins in FY08.
0604617F	Agile Combat Support	In FY 2008, Project 2895, Civil Engineering Readiness (CE), includes two new-start efforts.
0604708F	Civil, Fire, Environmental, Shelter	In FY 2008, the Air Force is in the process of consolidating three small dollar Civil Engineer (CE) readiness R&D programs (PE64617f - Agile Combat Support; PE64708f - Civil , Fire, Environmental, Shelters; and the 3600 portion of PE28031f - War Reserve Material) under PE 64617. This will meet the intent of the House action to eliminate smaller PEs and provide a more cohesive, manageable CE Readiness modernization effort.
0207450F	E-10 Squadrons	In FY 2008, 1 E-10A Testbed Aircraft (Commercial 767-400ER delivered in FY 2008) 1 GH DU radar for radar lab mode checkout and troubleshooting

BUDGET ACTIVITY #6: RDT&E MANAGEMENT SUPPORT (Volume 2)

0604759F	Major T&E Investment	In FY 2008, Project 4597, Air Force Test Investments, includes new start efforts

BUDGET ACTIVITY #7: OPERATIONAL SYSTEM DEVELOPMENT (Volume 3)

0205219F	MQ-9 Development and Fielding	In FY 2008, This program moved from PE 0305219F.

0207410F	Air and Space Operations Center - Weapon System	In FY 2008, Space C2 funds were transferred to the 674372 project line in the AOC PE to consolidate and unify Air Force air and space C2 development and integration. Starting in FY08 Project 674790 in PE 0207438F (Theater Battle Management Core Systems) was transferred to PE 0207410F (AOC WS) and placed into Projects 675218 (Applications Development) and 675220 (Unit Level).
0207438F	Theater Battle Management (TBM) C4I	In FY 2008, Project 674790 (Theater Battle Management Core Systems) was transferred to PE 0207410F (Air and Space Operations Center Weapon System), Projects 675218 (Applications Development) and 675220 (Unit Level).
0208021F	Information Warfare Support	In FY 2008, Funding for the Information Operations Planning Capability Joint (IOPC-J) BPAC 674871 transferred to JFCOM's PE 33166D beginning in FY08. FY08 - 13 funding decrease in BPAC 670374 as a result of alignment and correction of IW Support to JFCOM's PE 33166D.
0303112F	Aircomm	In FY 2008, this is a new start effort.
0305193F	Intel SPT to Info Ops	In FY 2008, the funding for the Joint Integrative Analysis and Planning Capability (JIAPC) was transferred to PE 33166D managed by JFCOM
0305219F	Predator Development/Fielding	In FY 2008, the MQ-9 Program moves to PE 0205219F. Historical MQ-9 accomplishments remain in this document.
0708611F	Support Systems Development	In FY 2008, the small amount of funds remaining for project 5044 (FY 2010) will be realigned during the FY 2008 budget cycle.

In accordance with the President's Management Agenda, Budget and Performance Integration initiative, these programs have been assessed using the Program Assessment Rating Tool (PART). Remarks regarding program performance and plans for performance improvement can be located at the Expectmore.gov website.

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

No.	Title
0603801F	Special Programs
0605798F	Analysis Support Group
0101815F	Advanced Strategic Program
0207248F	Special Evaluation Program
0207433F	Advanced Program Technology
0207424F	Evaluation and Analysis Program
0207591F	Advance Program Evaluation
0208160F	Technical Evaluation System
0208161F	Special Evaluation System
0301310F	National Air Intelligence Center
0301314F	COBRA BALL
0301315F	Missile and Space Technical Collection
0301324F	FOREST GREEN
0301386F	GDIP Collection Management
0304111F	Special Activities
0304311F	Selected Activities
0304312F	Special Applications Program
0304348F	Advanced Geospatial Intelligence (AGI)
0305124F	Special Applications Program
0305127F	Foreign Counterintelligence Activities
0305142F	Applied Technology and Integration
0305159F	Defense Reconnaissance Support Activities (SPACE)
0305172F	Combined Advanced Applications
0101314F	Night Fist

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Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
01 Basic Research

PE NUMBER AND TITLE
0601102F Defense Research Sciences

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	256.565	281.156	258.259	263.012	321.464	297.882	287.885	306.344	Continuing	TBD
2301	Physics	23.094	27.739	41.282	41.380	49.515	45.169	43.308	45.300	Continuing	TBD
2302	Solid Mechanics and Structures	13.844	17.028	17.029	17.270	19.132	18.334	18.678	19.438	Continuing	TBD
2303	Chemistry	29.574	36.322	32.166	31.480	37.475	35.572	35.950	37.676	Continuing	TBD
2304	Mathematics and Computing Sciences	25.639	31.200	23.283	25.298	31.480	28.121	25.812	26.754	Continuing	TBD
2305	Electronics	29.003	35.400	33.163	33.001	40.215	38.336	38.033	42.449	Continuing	TBD
2306	Materials	37.653	40.150	20.063	20.215	23.148	22.008	22.324	24.384	Continuing	TBD
2307	Fluid Mechanics	15.507	14.017	12.054	12.563	19.602	17.598	15.137	15.662	Continuing	TBD
2308	Propulsion	21.276	21.167	20.272	20.662	22.675	21.751	21.419	24.341	Continuing	TBD
2311	Information Sciences	29.653	26.900	25.412	27.180	36.238	32.413	28.850	29.995	Continuing	TBD
2312	Biological Sciences	9.486	10.014	10.396	10.295	12.153	11.516	12.113	12.927	Continuing	TBD
2313	Human Performance	13.402	12.556	11.120	11.254	16.255	13.945	12.424	12.715	Continuing	TBD
4113	External Research Programs Interface	8.434	8.663	12.019	12.414	13.576	13.119	13.837	14.703	Continuing	TBD

Note: In FY 2007, Project 2311 "Space and Information Sciences" changed its name to "Information Sciences." Space related effort moved to Project 2301 (Physics) in this Program Element in FY 2008.

(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 2007, Congress added $1M for Fully-Integrated Solar-Powered Interior Lighting Technology, $1.6M for New Methods for Designing and Testing Aircraft Coatings, $1M for Smart Surfaces and Interfaces, $1.7M for NanoPhotonic Components, $20M for National Aerospace Leadership Initiative, $2M for National Hypersonics Research Center, $2.9M for Coal-Based Jet-Fuel, and $1.8M for Virtual Teleoperations for Unmanned Aerial vehicles. This program is in Budget Activity 1, Basic research, because it funds scientific study and experimentation.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**

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

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	241.436	250.232	239.586	256.843
(U)	Current PBR/President's Budget	256.565	281.156	258.259	263.012
(U)	Total Adjustments	15.129			
(U)	Congressional Program Reductions		-0.010		
	Congressional Rescissions	-0.334	-1.066		
	Congressional Increases		12.000		
	Reprogrammings	20.955	20.000		
	SBIR/STTR Transfer	-5.492			

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2301 Physics**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2301 Physics	23.094	27.739	41.282	41.380	49.515	45.169	43.308	45.300	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: Space environment effort from Project 2311 and physical mathematics effort from Project 2304 will be moved to this Project in FY 2008 to more accuratley align basic research efforts in Physics.

(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; space sensors and imaging physics, space environment physics, electromagnetics, and applied analysis.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Investigate regulated, broad-spectrum, variable-energy lasers, laser arrays, and multi-aperture adaptive optics	7.867	9.535	9.475	9.407

(U) In FY 2006: Investigated physical properties of lasers to enable, monitor, and regulate tunable, wide wavelength band lasers. Continued investigating novel tomographic and optical techniques tied to large, multi-aperture, adaptive telescopes and radars. Explored use of directed energy beams for direct-write materials-processing techniques that offer new microelectronics and micromechanics fabrication and packaging capabilities. Continued 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) In FY 2008: Study mechanical, optical, and laser properties of ceramic materials as a function of material and preparation parameters. Investigate novel index, gain and doping profiles for high power, high beam, quality ceramic lasing. Study means for efficiently producing and making available quasi-phase matched semiconductor crystals for tunable high energy lasing. Study fundamental and practical limitations on efficiency and high temperature operation of mid-infrared semiconductor lasers, which have shown great promise for heat seeking missile countermeasures.

(U) In FY 2009: Investigate applications of previous research enabled large inexpensive, very bright

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	micro-plasma array ultraviolet sources to large flexible displays, materials curing, biological agent decontamination, and infectious disease treatment. Continue and expand research on high energy, tunable, all solid-state lasers. Study direct-write micro-systems, including onboard power sources. Apply 3-D laser write techniques in special glasses to inexpensive, flexible subsystems for space.				
(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.	10.550	13.466	13.242	13.315
(U)	In FY 2006: Characterized interactions of atoms and molecules in strong electromagnetic fields, and examined techniques for precision measurement of atomic and molecular properties, atomic collision processes, and fundamental interactions between atoms, molecules, ions, and radiation. Explored dynamic molecular interactions in combustion and high energy density propellants. Conducted research on the stunning effects of short-pulse, high intensity electric fields. Explored high power, high frequency device concepts and studies of new compact pulsed power technologies. Explored use of electron beam generated microwave for, high-bandwidth communications, advanced long-distance covert surveillance, electronic countermeasures, and directed energy weapons. Expanded 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. Used 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2301 Physics**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	electromagnetic launch concepts.				
(U)	In FY 2008: Explore usage of ultra-cold atoms and molecules for precision inertial navigation system components and ultra-precise measurement techniques using the results of previous research into atomic collision processes and fundamental interactions between atoms, molecules, ions, and radiation. Explore the possibility of tailor-making materials using the results of research in the overlap between atomic physics and condensed matter physics. Continue exploring new concepts for high-power, high-frequency electromagnetic radiation sources. Study quantum physics effects relating to the emission of electrons from surfaces. Examine the application of Chaos Theory effects to raise fundamental limits on electrical energy storage density. Study the seamless integration of magnetohydrodynamic and particle-in-cell modeling algorithms to better capture the detailed physics of high power microwave sources.				
(U)	In FY 2009: Continue studying the usage of ultra-cold atoms and molecules for precision inertial navigation system components and ultra-precise measurement techniques using the results of previous research into atomic collision processes and fundamental interactions between atoms, molecules, ions, and radiation. Continue exploring the possibility of tailor-making materials using the results of research in the overlap between atomic physics and condensed matter physics. Exploit emerging microfabrication methodologies for the realization of compact, high-frequency, high-power electromagnetic radiation sources. Continue studying quantum effects impacting electron emission from surfaces. Expand Chaos Theory studies to raise fundamental limits on electrical energy storage density. Create new simulation codes embodying both magnetohydrodynamic and particle-in-cell algorithms to realistically model high power microwave sources.				
(U)					
(U)	MAJOR THRUST: Advance technologies for space sensors, imaging, identification, and tracking methods, and effective space situational awareness.	3.953	4.738	4.708	4.901
(U)	In FY 2006: Studied fundamental issues of atmospheric and space environments concerning remote sensing, including propagation, image formation, and image recovery processes. Conducted research 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	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)	In FY 2008: Develop theoretical approaches to the surveillance and identification of space objects from both the ground and from space. Continue to study propagation of electromagnetic energy, image formation, image recovery, and information content maximization from both ground-based and space-based sensors. Investigate methods to mitigate environmental effects on sensors and sensor systems. Investigate atmospheric density forecast models to improve satellite orbit determination and tracking.				
(U)	In FY 2009: Continue to investigate fundamental limits affecting ground- and space-based surveillance of space objects. Develop improved adaptive optics and post-processing techniques for improved image resolution. Study spectral, polarimetric, and temporal approaches to unresolved space object identification. Continue the study of fundamental processes in the solar-terrestrial system that affects atmospheric density to lead to physics-based methods of satellite orbit prediction and precision tracking.				
(U)					
(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. Note: In FY 2008, Space Environment efforts previously in Project 2311 in this PE were moved into this Project to more accurately align Basic Research efforts in Physics.	0.000	0.000	4.949	4.913
(U)	In FY 2006: Not Applicable				
(U)	In FY 2007: Not Applicable				
(U)	In FY 2008: Begin using newly developed radio telescope instruments to probe the near-Earth space environment, to study solar phenomena, and to develop innovative methods for remote sensing the space environment as well as for heliospheric tomography. Investigate fundamental plasma modeling theory using new grid-free, full kinetic modeling techniques and develop novel techniques to include electromagnetism. Continue development of ground-based and space-based sensor technology for remote sensing and in situ measurement of space weather conditions. Continue to seek understanding of fundamental physics and processes controlling solar, heliospheric, magnetospheric, ionospheric, and thermospheric environments with a focus on improving forecast capabilities of the near-Earth space environment using first principles physics models. Continue developing understanding of fundamental processes of energetic particle scattering in the near-Earth environment to support protection of space				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	assets and to explore the solar interior as a complex system through advanced modeling techniques. Continue to analyze data from DoD surveillance satellites to improve remote sensing of interplanetary space. Maintain focused research to investigate the neutral densities and winds above 150 kilometers.				
(U)	In FY 2009: Emphasize development of cost effective micro satellites for space weather sensing. Investigate requirements of boundary conditions and initial values for driving space weather models. Exploit newly developed radio astronomy techniques for remote sensing the space environment in the continued search for understanding of fundamental physics and processes controlling solar, heliospheric, magnetospheric ionospheric and thermospheric environments with a focus on improving our ability to forecast near-Earth space environment using first principles physics models. Expand investigation of the fundamental plasma modeling theory using new electromagnetic, grid-free, full kinetic modeling techniques. Continue ground-based and space-based sensor technology development for remote sensing and in situ measurement of space weather conditions. Continue developing understanding of fundamental processes of energetic particle scattering in the near-Earth environment to support protection of space assets and to explore the solar interior as a complex system through advanced modeling techniques. Continue to analyze data from DoD surveillance satellites to improve remote sensing of interplanetary space. Maintain focused research to investigate the neutral densities and winds above 150 kilometers for satellite drag.				
(U)					
(U)	MAJOR THRUST: Research physical mathematics and applied analysis to develop accurate models of physical phenomena to enhance the fidelity of simulation. Conduct research in electromagnetics to produce conceptual descriptions of electromagnetic properties of novel materials/composites and simulate their uses in various operational settings. Note: In FY 2008, Physical Mathematics efforts previously in Project 2304 in this PE were moved into this Project to more accurately align Basic Research efforts in Physics.	0.000	0.000	8.908	8.844
(U)	In FY 2006: Not Applicable				
(U)	In FY 2007: Not Applicable				
(U)	In FY 2008: Continue to investigate properties of coherently propagating ultra-short laser pulses through the atmosphere with an emphasis on their ability to propagate through clouds and be used for target imaging. Continue to develop algorithms to simulate nonlinear optical effects within fiber lasers and nonlinear optical media with an emphasis on designs for 199KW laser weapons. Continue to investigate the dynamics of transonic/supersonic/hypersonic platforms with an emphasis on stores				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2301 Physics**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	release. Model the effects of the dynamics of the upper atmosphere on the stability of high altitude platforms as well as to assure the effective uses of their optical inventory. Study the design of reconfigurable warheads through suitable timing/placement of micro-detonators together with effects of metal particle inclusions. Continue to improve methods for recognizing and tracking targets and for penetrating coverings or other dispersive media that obscure targets so that radar emitting suitable waveforms can be used to image through foliage and clouds. Pursue the design of electromagnetic sources which, with the help of novel materials, can transmit optimized waveforms for a variety of surveillance purposes.				
(U)	In FY 2009: Investigate properties of coherently propagating ultra-short laser pulses through the atmosphere for their exploitation as high power microwave sources. Upgrade algorithms to simulate nonlinear optical effects within fiber lasers and nonlinear optical media so that simulation of various lasers can be realized. Initiate a modeling/simulation effort to codify the theoretical work on the dynamics of transonic/supersonic/hypersonic platforms to verify that designs and operations are near optimal. Model the effects of the dynamics of the upper atmosphere on the stability of high altitude platforms as well as to assure the effective uses of their optical inventory. Communicate these results to the airborne laser program and to the Air Force's Air Combat Command, for the latter's high altitude platforms. Verify the design of reconfigurable warheads through suitable timing/placement of micro-detonators as well as the effects of various metal inclusions on lethality. Continue to improve methods for recognizing and tracking targets and for penetrating coverings or other dispersive media that obscure targets. Pursue the design of electromagnetic sources which, with the help of novel materials, can transmit optimized waveforms for a variety of surveillance purposes and write numerical code which allows the user to simulate these sources.				
(U)					
(U)	CONGRESSIONAL ADD: Non-lethal Stunning/Immobilizing Weapons	0.724	0.000	0.000	0.000
(U)	In FY 2006: Accelerated fundamental scientific investigations in non-lethal stunning and immobilizing weapons research.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	23.094	27.739	41.282	41.380

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										

This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
01 Basic Research	**0601102F Defense Research Sciences**	**2302 Solid Mechanics and Structures**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2302 Solid Mechanics and Structures	13.844	17.028	17.029	17.270	19.132	18.334	18.678	19.438	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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.	6.842	8.040	8.076	8.196
(U) In FY 2006: Conducted 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. Conducted research on the autonomics to include the integration of energy harvesting/storage functions into load-bearing structures. Supported 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. Developed and exploited 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.				
(U) In FY 2008: Expand research in the area of multifunctional composite systems with structurally integrated antenna functions of broad bandwidth and improved structural endurance. Continue research				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	in the areas of diagnostics, prognostics, autonomics, self-healing, thermal management, energy harvesting/storage, and micro-/nano-mechanics to enable safer and more durable aerospace structures with improved performance characteristics. Further develop the fundamental knowledge required to design and manufacture multifunctional aerospace material systems and devices and to predict their performance and structural integrity. Continue developing and exploiting methods that combine information technology and multi-scale modeling in the design of new material systems and devices.				
(U)	In FY 2009: Continue research in the area of multifunctional hybrid composite systems for sensing and neutralization of exogenous threats to load-bearing capability. Continue research in the areas of diagnostics, prognostics, autonomics, self-healing, thermal management, energy harvesting/storage, electromagnetic energy radiation/transmission, and micro-/nano-mechanics 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 multi-scale modeling in the design of new material systems.				
(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).	7.002	8.988	8.953	9.074
(U)	In FY 2006: Explored methods for constructing and modeling morphing structures that broaden system operational capabilities. Developed novel actuation devices and materials for applications such as micro-UAV aircraft and space structures. Investigated metal fatigue-generation caused by the vibration of compressors and turbine blades. Developed structural health monitoring techniques and systems. Explored the mechanical and dynamic behavior of micro-/nano-scale structures. Exploited 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	as structural deformation and aero-elastic effects in novel structural applications.				
(U)	In FY 2008: Develop novel theoretical and experimental methods for constructing and modeling morphing structures that broaden system operational capabilities. Continue development of novel actuation devices and materials for a variety of Air Force applications to aircraft and space structures. Study the science issues related to the introduction into new structural concepts of the novel materials developed under the advanced materials programs. Use the knowledge acquired about the novel materials to develop new aerospace structural concepts. Develop an integrated approach to structural systems lifetime prognosis. Continue the development of structural health monitoring sensors and techniques towards an integrated vehicle-wide approach. Consolidate the exploration of mechanical and dynamic behavior of micro-/nano-scale structures. Expand the investigation of nonlinear phenomena associated with the structural deformation and aero-elastic instabilities and limit-cycle vibration to include novel structural concepts.				
(U)	In FY 2009: Expand the novel theoretical and experimental methods in morphing aircraft structures to achieve broader operational capabilities. Utilize novel actuation devices and materials for Air Force aircraft and space structural applications. Expand the study of the science related to the acceptance into new structures of the novel materials developed under the advanced materials programs. Use this acquired knowledge to develop new aerospace structural concepts. Continue the development of structural health monitoring sensors and techniques towards an integrated vehicle-wide approach. Consolidate an integrated approach to structural systems lifetime prognosis and reliability. Expand the understanding of mechanical and dynamic behavior of micro-/nano-scale structures to generate novel structural concepts. Continue investigation of nonlinear phenomena associated with the structural deformation and aero-elastic instabilities and limit-cycle vibration to include novel structural concepts.				
(U)	Total Cost	13.844	17.028	17.029	17.270

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0602102F, Materials.										
(U)	PE 0602201F, Aerospace Flight Dynamics.										
(U)	PE 0602202F, Human										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

Effectiveness Applied Research.

(U) PE 0602203F, Aerospace Propulsion.

(U) PE 0603211F, Aerospace Structures.

This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE **February 2007**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
01 Basic Research	**0601102F Defense Research Sciences**	**2303 Chemistry**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2303 Chemistry	29.574	36.322	32.166	31.480	37.475	35.572	35.950	37.676	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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.	12.420	14.926	14.511	13.874
(U) In FY 2006: Conducted theoretical chemistry research to predict promising new chemicals of interests to the Air Force and to guide their efficient synthesis. Enhanced efforts to develop higher performance, less sensitive nano-scale energetic materials for applications in munitions and propellants. Supported 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 utilizing 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 for applications in munitions and propellants.				
(U) In FY 2008: Develop new theoretical and computational methods to enhance capabilities to predict and simulate properties of chemicals and materials of interest to the Air Force. Continue to develop new experimental methods to advance understanding of reactivity and energy flow in molecules for				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	applications to signatures, battlespace awareness, propellants, munitions, and laser systems. Explore ability to understand and control catalysis and plasmonic structures to enhance propulsion and energetic applications and sensitive detection of target compounds.				
(U)	In FY 2009: Continue to develop new capabilities to predict molecular and macroscopic properties of chemicals of interest to the Air Force. Explore properties and potential of nano-scale energetic materials. Continue to develop new experimental methods to advance understanding of reactivity and energy flow in molecules for applications to signatures, battlespace awareness, propellants, munitions, and laser systems. Continue to develop novel applications of catalysis and plasmonic structures for applications to propulsion, energetics, and sensing. Explore new concepts for closed-cycle hybrid chemical lasers.				
(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.	9.096	10.373	10.196	10.133
(U)	In FY 2006: Conducted research to enhance optical nonlinearity for laser protection applications. Exploited nanotechnology to develop compact solar arrays, fuels cells, and power storage systems to provide lightweight power sources for space assets. Exploited 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)	In FY 2008: Explore power generation and power storage for warfighters based on improved polymers for solar cells and fuel cells applications. Continue to explore photonic polymers and conductive polymers for communications and detections. Investigate 3-D displays based on photorefractive polymers. Polymers with controlled dielectric permittivity and magnetic permeability will be explored for advanced radar antenna applications. Controlled growth mechanisms of carbon single wall nanotubes will be investigated.				
(U)	In FY 2009: Continue to exploit nanotechnology to enhance functional and mechanical properties of polymers through controlled dispersion, distribution, and placement of the nano-entities for Air Force applications. Controlled synthesis of new polymers with improved power generation and storage				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	functions will be explored. Modeling, synthesis, and characterization of conjugated polymers will be conducted to understand, and enhance the charge mobility of organic based semi-conducting organics and polymers.				
(U)					
(U)	MAJOR THRUST: Expand the fundamental chemistry and physics of surfaces and interfacial processes pertaining to corrosion protection, wear reduction, and power storage for air and space systems.	6.707	7.514	7.459	7.473
(U)	In FY 2006: Conducted research on 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. Investigated 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. Synthesized and characterized novel multi-functional surface structures, coatings, covers, and lubricants. Explored nano-scale surface structures and systems for electronic, power, and sensing applications.				
(U)	In FY 2007: Explore 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 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)	In FY 2008: 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. Continue to investigate phenomena at surface interfaces, including friction and wear, lubrication, corrosion and degradation. Explore novel approaches to corrosion prevention, particularly multi-disciplinary efforts that combine corrosion initiation, detection, and lifetime prediction. Continue tribological investigations that focus on bridging the fundamental gap between macro and nano scale mechanisms, including heat transfer, chemical reactivity, and atmospheric effects. Continue to investigate nano-scale surface structures for power applications.				
(U)	In FY 2009: Continue to 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. Continue to investigate phenomena at surface interfaces, including friction and wear,				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	lubrication, corrosion and degradation. Explore novel approaches to corrosion prevention, particularly multi-disciplinary efforts that combine corrosion initiation, detection, and lifetime prediction. Continue tribological investigations in nanocomposite lubricants that provide function over a wide variety of extreme environments, including space.				
(U)					
(U)	CONGRESSIONAL ADD: New Methods for Designing and Testing Aircraft Coatings (Note: In FY 2006, this add was called Al Alloys Used in Aging Aircraft)	1.351	1.559	0.000	0.000
(U)	In FY 2006: Conducted research on corrosion protection of Aluminum Alloys used in aircraft.				
(U)	In FY 2007: Conduct research to explore environmentally friendly and longer-lasting anti-corrosion coatings for aging aircraft.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable				
(U)					
(U)	CONGRESSIONAL ADD: Fully-Integrated Solar-Powered Interior Lighting Technology	0.000	0.975	0.000	0.000
(U)	In FY 2006: Not Applicable				
(U)	In FY 2007: Conduct research to integrate solar-energy-generating photovoltaic materials and light-emitting organic materials for self-contained lighting systems for combat locations.				
(U)	In FY 2008: Not Applicable				
(U)	In FY 2009: Not Applicable				
(U)					
(U)	CONGRESSIONAL ADD: Smart Surfaces and Interfaces	0.000	0.975	0.000	0.000
(U)	In FY 2006: Not Applicable				
(U)	In FY 2007: Conduct research to explore surfaces and interfaces that respond smartly to the surroundings				
(U)	IN FY 2008: Not Applicable				
(U)	In FY 2009: Not Applicable				
(U)					
(U)	Total Cost	29.574	36.322	32.166	31.480

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2303 Chemistry**

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										

This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2304	Mathematics and Computing Sciences	25.639	31.200	23.283	25.298	31.480	28.121	25.812	26.754	Continuing	TBD
	Quantity of RDT&E Articles	0	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, optimization and discreet mathematics, and computational mathematics.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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. Increasing level of efforts are required by Air Force priority that depends on basic reserch in this major thrust.	7.814	9.619	12.001	13.307

(U) In FY 2006: Explored cooperative control in dynamic, uncertain, adversarial environments with applications to swarms of smart munitions, unmanned aerial vehicles (UAVs), and constellations of small satellites. Examined control methodologies to improve non-equilibrium behavior of complex, unsteady fluid systems with applications for combustion, materials processing, and agile autonomous flight. Improved 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 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.

(U) In FY 2008: Investigate emerging novel approaches for cooperative control systems in dynamic,

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2304 Mathematics and Computing Sciences**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	uncertain, adversarial environments with applications to swarms of smart munitions, UAVs, and constellations of small satellites. Conduct additional research for teams of micro air vehicles operating at various altitudes in complex environments to execute assigned missions with variable operator intervention. Advance control methodologies and modeling 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. Advance methods for design and analysis of bio-inspired sensing systems, controls, and computational systems. Continue development of algorithms for control of and over dynamic, large-scale networks. Investigate theory and algorithms for specification, design, verification, and validation of distributed embedded systems. Research potential devices to exploit nonlinear dynamic phenomena with a focus on detection, classification, and control systems for use in urban combat environments.				
(U)	In FY 2009: Further develop the design and analysis techniques for cooperative control systems in dynamic, uncertain, adversarial environments with applications to swarms of smart munitions, UAVs, and constellations of small satellites. Continue the additional research for teams of micro air vehicles operating at various altitudes in complex environments to execute assigned missions with variable operator intervention. Continue developing control methodologies to improve non-equilibrium behavior of complex, unsteady fluid systems. Continue to advance image processing and sensor technologies for use in UAV controllers, smart munitions, and non-destructive vehicle testing. Develop methods for design and analysis of bio-inspired sensing systems, controls, and computational systems. Continue development of algorithms for control of and over dynamic, large-scale networks. Develop theory and algorithms for specification, design, verification, and validation of distributed embedded systems. Design novel devices to exploit nonlinear dynamic phenomena with a focus on detection, classification, and control systems for use in urban combat environments.				
(U)					
(U)	MAJOR THRUST: Research physical mathematics, applied analysis, and electromagnetics. Note: In FY 2008, Physical Mathematics efforts previously in this Project were moved into Project 2301 in this PE to more accurately align Basic Research efforts in Physics.	8.365	10.123	0.000	0.000
(U)	In FY 2006: Developed more accurate models of physical phenomena to enhance the fidelity of simulations. Investigated properties of coherently propagating ultra-short laser pulses through the atmosphere. Developed algorithms to simulate nonlinear optical effects within fiber lasers and nonlinear				

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	optical media. Studied the dynamics of transonic/supersonic/hypersonic platforms. Studied the design of reconfigurable warheads through suitable placement and of micro-detonators. Improved 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)	In FY 2008: None				
(U)	In FY 2009: None				
(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.	9.460	11.458	11.282	11.991
(U)	In FY 2006: Conducted research on complex problems in system diagnostics/prognostics, air mobility contingencies, target tracking, and strategic/tactical planning for battlespace information management. Developed innovative methods and algorithms that will improve modeling and simulation capabilities. Continued 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. Developed mathematical method for solving large or complex problems in logistics, air mobility contingencies, target tracking, and strategic/tactical planning for battlespace information management. Conducted computational research on 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,				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

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) In FY 2008: Continue to develop mathematical methods for solving large and complex problems in logistics, system diagnostics/prognostics, air mobility contingencies, target tracking, and strategic/tactical planning for battlespace information management. Approaches will include both rigorous analytical tools, and meta heuristic searches. Continue to develop innovative mathematical and numerical algorithms that will improve modeling and simulation capabilities in order to increase understanding, prediction, and design of large and complex phenomena of interest to the Air Force. These phenomena include aerodynamics for various flight regimes, high power microwaves, material design and structural mechanics. Continue to develop and 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, micro air vehicles, air and space components, and system health and maintenance systems. Enhance uncertainty quantification based on rigorous error analysis in non-linear models of aerodynamic flows and structural failure predictions. Develop mathematical models that are dynamically evolving that would deal with operational data that are possibly incomplete, uncertain, conflicting, or overlapping.

(U) In FY 2009: Develop rigorous mathematical methods for solving large and complex problems in logistics, system diagnostics/prognostics, air mobility contingencies, target tracking, and strategic/tactical planning for battlespace information management. Enhance the analytical tool developments in operation research, meta heuristic searches, and robust and stochastic optimization. Focus on developing innovative and accurate mathematical and numerical algorithms that will improve modeling and simulation capabilities. These phenomena include aerodynamics as applicable to a range of flight regimes such as hypersonics and micro air vehicles. Continue to develop and 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 enhance uncertainty analysis in non-linear models of aerodynamic flows and structural failure predictions. Continue to develop mathematical models that

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2304 Mathematics and Computing Sciences**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	are dynamically evolving that would deal with operational data that are possibly incomplete, uncertain, conflicting, or overlapping.				
(U)	Total Cost	25.639	31.200	23.283	25.298

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 Development.										

This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE
February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
01 Basic Research	**0601102F Defense Research Sciences**	**2305 Electronics**

Cost ($ in Millions)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2305	Electronics	29.003	35.400	33.163	33.001	40.215	38.336	38.033	42.449	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) **A. Mission Description and Budget Item Justification**

Electronics basic research generates and exploits fundamental knowledge and understanding of novel solid-state electronic, sensor, and optoelectronic materials and device implementation schemes vital to advance Air Force operational capabilities in surveillance, information and signal processing, communications, command and control, electronic countermeasures, stealth technologies, and directed energy weapons. Solid-state electronics research discovers and develops new materials, advances processing and fabrication sciences, and develops and implements advanced physical modeling and simulation capabilities essential to evaluate novel electronic, sensor, and optoelectronic structures and device concept implementation schemes. Research stresses high-risk, far-term, game-changing capability breakthroughs essential for future leaps in warfighter system performance, functionality, reliability, and survivability while simultaneously reducing component and system power, size, mass, and lifecycle costs.

(U) **B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Investigate novel detector and electronic materials, device concepts, and circuit architecture and implementation schemes important to future military space platforms for increased system reliability, survivability, and functionality while simultaneously reducing component power, size, and mass. Research is focused on high-risk, innovative, and potential-breakthrough materials, devices, and circuit concepts enabling for future generation high-sensitivity multispectral detection, high-speed and high-throughput data processing, high-density non-volatile data storage, and advanced high-power, broad-band, highly efficient X-W band radar and communications.	6.237	7.805	7.832	7.882
(U) In FY 2006: Concluded major effort to understand RF pulse effects on electronic circuits. Launched new university center of excellence on radiation effects on electronic materials and devices. Transitioned the results from basic research efforts to baseline gallium nitride bulk material. Closely reviewed and re-vectored 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) In FY 2008: Investigate novel reconfigurable multifunctional electronic materials that show potential for dynamically tailoring their physical properties via application of one or more 'stimuli', such as electric and/or magnetic fields, optical signals, heat, mechanical stress, chemical processes, etc., with the				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	end objective of precisely tuning their physical properties in response to dynamically changing electronic and/or optoelectronic device, circuit, or system requirements, such as that driven by natural or radiation induced degradation and/or changing mission requirements. Investigate innovative multispectral and multi-phenomenology-based detector concepts/approaches utilizing breakthroughs in material electronic bandgap and defect-band tuning concepts, absorption phenomenology-based detection mechanisms, novel material and device functionality, novel hetero-material interfacing and interconnect schemes, and biologically-based detection processes.				
(U)	In FY 2009: Continue investigating novel innovative reconfigurable multifunctional electronic materials, material bandgap and defect-band tuning concepts, phenomenology-based detection mechanisms, novel hetero-material interfacing and interconnect schemes, and novel nanoscience and biologically-based detection processes. Investigate 'smart' reconfigurable materials whose properties can be dynamically tailored via self-programming or system software in response to changing behavior or mission needs. Focus on novel 'programmable pathways' to enable tailoring novel hybrid material systems such as metamorphic and heterogeneous systems.				
(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, and target signature identification.	12.189	14.981	14.332	14.107
(U)	In FY 2006: Investigated nonlinear optical and laser materials, devices, and fabrication processes for radiation protection, cloaking and tracking, and target signature identification. Explored nanoelectronics, nanophotonics, and other advanced optoelectronic and electronic materials and devices for lower power consumption, high-efficiency lasers wavelength-diverse, high sensitivity detectors. Studied advanced optical memory technologies for enhanced data storage. Continued to probe robust monolithic and miniature terahertz frequency spectrum devices and quantum cascade lasers. Continued 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.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	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)	In FY 2008: Continue to 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, spintronics 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, including negative index of refraction metastructures. 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)	In FY 2009: 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, spintronics, multi-functional materials, and other advanced optoelectronic, magnetic, 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, including negative index of refraction metastructures and photonic crystals. Investigate technologies for robust monolithic and miniature terahertz frequency spectrum devices and quantum cascade lasers, as well as plasmonics. 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.	3.818	5.266	5.290	5.254
(U)	In FY 2006: Explored techniques to control growth of self-assembled quantum structures and connections to these structures for multi spectral image processing. Developed guided wave and free spaceoptoelectronic 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	high-speed information processors. Explored nanophotonic 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 methods 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)	In FY 2008: Further develop and refine techniques to control growth of self-assembled quantum structures and connections to these structures for multi-spectral image processing. Test functionalities of structural materials and improve growth methods. Continue developing nanoelectronics and nanophotonics for guided wave and free space optoelectronic device technology and methods 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)	In FY 2009: Exploit controlled growth of self-assembled quantum structures and connections to these structures for multi-spectral image processing. Continue testing functionalities of structural materials and improve growth methods. Continue developing and improving knowledge of nanoelectronics and nanophotonics for guided wave and free space optoelectronic device technology and methods 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.	5.022	5.689	5.709	5.758
(U)	In FY 2006: Conducted research on superconducting quantum computing systems and encryption techniques. Examined methodologies to fabricate high current, high-temperature superconducting materials for enhanced power generation and storage devices. Continued 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	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)	In FY 2008: Recent success in increasing current-carrying properties of high-temperature superconducting short sections of tape will be exploited to increase those properties in longer lengths and attempts will be made to reduce eddy-current loses. Microwave properties of high-temperature superconductors will receive added emphasis because of recent progress in reducing losses at high frequencies. The goal is to provide thin-film superconducting material that can provide improved radar systems and compact communications systems. The search for practical even higher-temperature superconductors will continue. Efforts to create true 3-D negative index material at frequencies from microwave to infrared and visible will be augmented. The search for higher-temperature, high-energy-product magnetic materials will continue using innovative nanomaterial technology. Using carbon nanotubes and other nanomaterials, new compact architectures will be created to further miniaturize devices for signal processing, memory storage, and sensing.				
(U)	In FY 2009: Using improved planar thin-film Josephson-junction technology, a low-noise, wide-bandwidth amplifier will be constructed and tested. Attempts to fabricate high-temperature, high-performance magnetic materials will be given greater emphasis in providing support for the More Electric Airplane and other advanced systems. Studies to reduce eddy-current losses and to prevent quenching in superconducting tapes will be augmented as the tape technology reaches desired goals. Progress in seeking practical negative index materials over a broad range of frequencies will continue. Nanoelectronic circuitry based on nanomaterials and new concepts also will receive added emphasis in attempting to promote miniaturization, greater functionality and lower losses. Searches for new higher-temperature (and practical) superconductors will continue.				
(U)					
(U)	CONGRESSIONAL ADD: Nanophotonic Components	1.737	1.659	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for nanophotonic components utilized in electronic materials in a number of aircraft, ship, and soldier systems.				
(U)	In FY 2007: Conduct basic research in nano-materials and nano-manufacturing for military photonic applications				
(U)	In FY 2008: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2305 Electronics**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	29.003	35.400	33.163	33.001

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										

This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE **February 2007**

BUDGET ACTIVITY **01 Basic Research**

PE NUMBER AND TITLE **0601102F Defense Research Sciences**

PROJECT NUMBER AND TITLE **2306 Materials**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2306 Materials	37.653	40.150	20.063	20.215	23.148	22.008	22.324	24.384	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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.	7.627	9.785	9.539	9.622
(U) In FY 2006: Conducted research to optimize the thermal and mechanical stability of oxide composites for aircraft and engine applications. Identified new approaches to designing multi-functional structural ceramics materials to enable structurally enhanced smart systems. Investigated high-temperature resistant and lightweight non-oxide ceramic materials. Conducted research on high temperature polymer matrix composites in terms of their durability in harsh environments and its processibility in fabricating high performance structural components. Developed 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 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	multi-functional performance of load-bearing aerospace structures.				
(U)	In FY 2008: Continue to optimize the design of multi-functional structural ceramics materials to enable structurally enhanced smart systems for application in extreme environments. Exploit new approaches in improving the thermal and mechanical stability of oxide ceramic composites for aircraft and engine applications. Further develop high-temperature resistant and joining methodologies for lightweight ceramic materials. Continue to develop innovative concepts for developing higher temperature and more damage-tolerant organic, inorganic, and polymer matrix composites. Continue to develop the fundamental knowledge base to exploit the use of nanomaterials and nanocomposites in aerospace structures.				
(U)	In FY 2009: Continue optimizing the design of multi-functional structural ceramics materials to enable structurally enhanced smart systems for application in extreme environments. Expand the development of new approaches in improving the thermal and mechanical stability of oxide ceramic composites for aircraft and engine applications. Continue to further develop high-temperature resistant and joining methodologies for lightweight ceramic materials. Expand the development of innovative concepts for developing higher temperature and more damage-tolerant organic, inorganic, and polymer matrix composites. Continue to expand the development of the fundamental knowledge base to exploit the use of nanomaterials and nanocomposites in aerospace structures.				
(U)					
(U)	MAJOR THRUST: Research metallic materials and identify relationships between structures (including microstructures), processing, properties, and performance so as to develop affordable and durable metallic systems for advanced engines and aerospace structural applications.	9.757	10.865	10.524	10.593
(U)	In FY 2006: Conducted research on lightweight structural materials, refractory metals, intermetallic alloys, amorphous alloys and their composites, and micro-laminated materials for sustainable use in aerospace applications. Developed and verified 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)	In FY 2008: Continue investigating metallic materials for sustainable use in structural applications and advanced engines. Investigate nano-laminates and nano-composites for aerospace armor and small				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	air-vehicle structures. Explore the interaction between chemistry and mechanics in surfaces and interfaces of these nanoscale structures. Explore the processing and development of multifunctional structural metals for power systems and space applications. Capitalize on advances in multiscale modeling to study the response of aerospace alloys exposed to corrosive environments and cyclical loading. Develop an informatics process exploiting disparate sources of materials' properties data derived from modeling and experimentation. Explore the fundamental science of friction and thermal effects during friction stir processing.				
(U)	In FY 2009: Further investigate nano-laminates and nano-composites for aerospace armor and small air-vehicle structures. Explore the interaction between chemistry and mechanics in the surfaces and interfaces of these nanoscale structures. Further explore the processing and development of multifunctional structural metals for power systems and space applications. Further develop and verify multiscale models to study the response of aerospace alloys exposed to corrosive environments and cyclical loading. Continue development of an informatics process to exploit disparate sources of materials' properties data derived from modeling and experimentation. Continue research on the fundamental science of friction and thermal effects during friction stir processing. Investigate affordable and environmentally sustainable methods to process aerospace alloys.				
(U)					
(U)	CONGRESSIONAL ADD: National Aerospace Leadership Initiative	20.269	19.500	0.000	0.000
(U)	In FY2006: Established a broad based agenda to reinvigorate US's aerospace research and development and maintain US's competitive leadership in aviation				
(U)	In FY 2007: Support aerospace R&D, fortify US-based manufacturing supply chain, and strengthen aerospace equipment manufacturers' R&D.				
(U)	In FY 2008: Not Applicable				
(U)	In FY 2009: Not Applicable				
(U)	Total Cost	37.653	40.150	20.063	20.215

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602102F, Materials.										
(U) PE 0602201F, Aerospace										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

Flight Dynamics.
(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.

This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
01 Basic Research	**0601102F Defense Research Sciences**	**2307 Fluid Mechanics**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2307 Fluid Mechanics	15.507	14.017	12.054	12.563	19.602	17.598	15.137	15.662	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Investigate and characterize complex phenomena in supersonic, hypersonic, boundary layers, and turbulent flows to enable and optimize the design of air and space vehicles and flight control systems.	4.935	5.485	5.525	6.464

(U) In FY 2006: Explored methods to optimize unsteady, vortex-dominated flows and rapid maneuver controls on UAVs. Modeled and validated unsteady hypersonic flow simulation tools to include boundary layer effects, engine inlets, and plasma aerodynamics. Modeled aerothermal and local shock phenomena in hypersonic flows with emphasis on control concepts and performance optimization. Explored 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) In FY 2008: Characterize and model fundamental phenomena of three-dimensional high-speed boundary layers to facilitate prediction and control of laminar-turbulent transition and the onset of severe heating rates in high-speed systems. Extend applicability and capability to handle complex flows

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2307 Fluid Mechanics**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	of high-fidelity, unsteady numerical models for shock-dominated flows, and nonequilibrium effects. Continue development of control strategy models for mitigating excessive heat transfer and unsteadiness in hypersonic flows and for abating the effects of highly separated flows.				
(U)	In FY 2009: Extend efforts to characterize and model fundamental phenomena of high-speed boundary laminar-turbulent transition to include interactions between multiple instability modes. Validate high-fidelity, unsteady numerical simulation methodologies for shock-dominated flows and nonequilibrium effects. Extend strategies for control of excessive heat transfer, unsteadiness, and separation in hypersonic flows to reduce severe local loads on systems. Explore interactions between severe phenomena in aerothermodynamic environment and high-temperature vehicle materials with the goal of reducing thermal protection system complexity and increasing performance to improve reusability, sustainability, efficiency, and turn time of hypersonic and space-access systems.				
(U)					
(U)	MAJOR THRUST: Expand fundamental knowledge of unsteady flows in integrated theoretical, experimental, and computational efforts. Study complex rotating and internal flow phenomena related to turbomachinery and jet engine applications with an emphasis on flow control approaches.	5.745	6.583	6.529	6.099
(U)	In FY 2006: Validated studies of advanced flow control coupling mechanisms in complex, turbulent flows. Validated large eddy simulation techniques to probe heat transfer and fluid flow coupling. Continued to model unsteady flow control inputs on wings and jet engines to include reduced order, closed-loop flow control demonstrations. Further explored and developed models for aerodynamic mistuning mechanisms in multiple blade row interactions tied to high cycle fatigue failures. Further developed 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)	In FY 2008: Further develop reduced order, closed-loop flow control mechanisms on unsteady flows of				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2307 Fluid Mechanics**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	complex geometries and jet engines. Investigate new applications of flow control techniques to improve jet engine integration and efficiency for a wider range of flight operating conditions. Develop tools for predicting and controlling unsteady, vortex-dominated flows on unmanned aerial vehicles (UAVs). Explore and develop innovative techniques for improving convective heat transfer at all flow scales to enhance thermal management of subsonic and supersonic flight systems.				
(U)	In FY 2009: Continue to develop reduced order, closed-loop flow control mechanisms on unsteady flows of complex geometries and jet engines and identify specific applications to transition technology. Characterize and model promising applications of flow control techniques to improve jet engine integration and efficiency for a wider range of flight operating conditions. Validate tools for predicting and controlling unsteady, vortex-dominated flows on UAVs. Continue to develop innovative techniques for improving convective heat transfer at all flow scales to enhance thermal management of subsonic and supersonic flight systems.				
(U)					
(U)	CONGRESSIONAL ADD: National Hypersonic Research Center	1.931	1.949	0.000	0.000
(U)	In FY 2006: Conducted fundamental scientific and engineering research studies at the National Hypersonics Research Center.				
(U)	In FY 2007: Conduct research on experimental and numerical simulation to characterize and develop predictive numerical methods for physical phenomena associated with hypersonics.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable				
(U)					
(U)	CONGRESSIONAL ADD: Notre Dame Center for Flow Physics and Control	2.896	0.000	0.000	0.000
(U)	In FY 2006: Enabled basic research in aero-optics and flow control by acquiring a subsonic wind tunnel and diagnostic equipment that directly impacts AF far term technology goals.				
(U)	In FY 2007: Not Applicable				
(U)	In FY 2008: Not Applicable				
(U)	In FY 2009: Not Applicable				
(U)	Total Cost	15.507	14.017	12.054	12.563

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2307 Fluid Mechanics**

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										

This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
01 Basic Research	**0601102F Defense Research Sciences**	**2308 Propulsion**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2308 Propulsion	21.276	21.167	20.272	20.662	22.675	21.751	21.419	24.341	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Research and model space propulsion and power in the areas of chemistry, electronics, miniaturization, and contamination/signature.	8.184	9.118	9.109	9.257
(U) In FY 2006: Conducted research on plasma-based, charged droplet based, and beamed-energy thrusters. Continued studies of pulsed detonation rocket engines and other new engine concepts. Evaluated methods to predict and suppress combustion instabilities. Investigated high altitude plumes signature and contamination. Examined magnetohydrodynamic (MHD) flow control to optimize scramjet flow path performance. Continued to investigate lightweight superconducting magnet capability for MHD flow control of advanced engines.				
(U) In FY 2007: Continue research on 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) In FY 2008: Conduct studies of small satellite, microsatellite, and nanosatellite propulsion and investigate plasma dynamics in these thrusters. Evaluate methods to predict and suppress combustion instabilities under supercritical conditions, and develop research models that can be incorporated into the design codes. Develop novel diagnostic techniques for characterization of combustion instabilities in high pressure, harsh, optically thick environments. Continue to investigate high altitude plumes				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	signature and contamination. Investigate alternate launch systems using electromagnetic forces as a rail-gun or coil-gun. Conduct research to enable revolutionary designs of satellite systems that can achieve the simultaneous objectives of increasing payload and/or time in orbit and increasing mission flexibility and scope.				
(U)	In FY 2009: Continue studies of small satellite, microsatellite, and nanosatellite propulsion and investigate plasma dynamics in these thrusters. Continue to investigate high altitude plumes signature and contamination. Continue investigating alternate launch systems using electromagnetic forces as a rail-gun or coil-gun. Conduct fundamental component and system level research that leads to the introduction of novel multi-use technologies and concepts in order to achieve multi-functional satellite architectures and the development of highly efficient power generation/recovery systems (e.g., micro electro-mechanical turbines and nano-structured thermoelectric units) deeply integrated with thermal management or spacecraft structure. Enhance novel diagnostic techniques for characterization of combustion instabilities in high pressure, harsh, optically thick environments.				
(U)					
(U)	MAJOR THRUST: Explore combustion, propulsion, and diagnostics in subsonics, supersonics, and hypersonics. Investigate multi-phase, turbulent reacting flows to improve the performance of propulsion systems, including gas turbines, ramjets, scramjets, pulsed detonation engines, and rockets. Starting in FY 2008, Conduct basic research in support of higher AF priority (Energy Conservation -Assured Fuels Initiative) to identify and develop technologies that enable the use of domestic fuel sources for military energy needs.	8.266	9.222	11.163	11.405
(U)	In FY 2006: Conducted research to improve laser diagnostic measurement capabilities in the characterization of turbulent reacting flows. Probed deeper into molecular transport effects causing and enhancing thermal destabilization of hydrocarbon fuels under supercritical thermodynamic conditions. Further 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. Investigated 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2308 Propulsion**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	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)	In FY 2008: Continue improving laser diagnostic measurement capabilities, investigations of molecular transport effects causing and enhancing thermal destabilization of hydrocarbon fuels under supercritical thermodynamic conditions, and prediction methodologies, which are both quantitatively accurate and computationally tractable, for turbulent combustion models. Further enhance scientific bases for how plasmas are used to improve aerodynamic characteristics and propulsive efficiencies. Expand strategies for using alternate hydrocarbon fuels based on the incorporation of detailed chemistry and transport models through surrogate fuel representations. Conduct research to provide fuel-flexible energy conversion technology in support of the Energy Conservation -Assured Fuels Initiative.				
(U)	In FY 2009: Continue improving laser diagnostic measurement capabilities, investigations of molecular transport effects causing and enhancing thermal destabilization of hydrocarbon fuels under supercritical thermodynamic conditions, and prediction methodologies, which are both quantitatively accurate and computationally tractable, for turbulent combustion models. Continue exploring the scientific bases for how plasmas are used to improve aerodynamic characteristics and propulsive efficiencies. Exploit strategies for using alternate hydrocarbon fuels by inserting reduced fuel representations into comprehensive combustion models such as large eddy simulations. Conduct research to provide fuel-flexible energy conversion technology in support of the Energy Conservation -Assured Fuels Initiative.				
(U)					
(U)	CONGRESSIONAL ADD: Coal-Based Jet Fuels.	4.826	2.827	0.000	0.000
(U)	In FY 2006: Conducted research to produce 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 2007: Continue research to produce coal-based jet fuels. Assess military utility and suitability of this fuel.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2308 Propulsion**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	Total Cost	21.276	21.167	20.272	20.662

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										

This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2311 Information Sciences**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2311 Information Sciences	29.653	26.900	25.412	27.180	36.238	32.413	28.850	29.995	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: This project is renamed from "Space and Information Sciences" to "Information Sciences" in FY 2007. Space related effort will be moved to Project 2301 in this Program Element in FY 2008.

(U) A. Mission Description and Budget Item Justification

Information sciences basic research generates fundamental knowledge and understanding to support critical Air Force capabilities in information superiority, precision targeting (or strike), and improved battlespace awareness. Areas of research focus are (1) access to disparate data and information, (2) information fusion and distribution, and (3) conversion of information into knowledge to support decision making. The data, fusion engines, and command and control functions reside on interlocking systems connected by networks leading to a system of systems architecture. Areas of research underpinning these team-focused, network-enabled systems are those in networks and communications, software, information management, and human-system interactions. Complementing these overall focus areas, research is occurring in the following areas: information operations (CNA and CND); network, software and system architectures; information fusion; information forensics; and communications and signals; control of large systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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. Note: In FY 2008, Space efforts previously in this Project will be moved into Project 2301 in this PE to more accurately align Basic Research efforts in Physics.	8.304	9.198	0.000	0.000
(U) In FY 2006: Explored advanced modeling algorithms to take advantage of increased computer power and speed. Sought improved plasma models to enhance understanding of basic plasma theory. Studied fundamental processes of energetic particle scattering in the near-Earth environment to lay groundwork for protection of space assets. Investigated solar processes and energetic events, the solar wind, and fundamental processes in the magnetosphere, ionosphere, and thermosphere. Searched for understanding of fundamental processes controlling space plasma to improve ability to forecast near-Earth space environment. Exploited data from DoD surveillance assets in conjunction with data from C/NOFS-SMEI satellites to improve remote sensing of interplanetary space. Developed ground-based optical telescope technologies to include adaptive optics, photon detection, spectral resolution, nanotechnology, advanced signal-processing algorithms, and developing space-based sensor technology. Exploited 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2311 Information Sciences**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	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)	In FY 2008: None				
(U)	In FY 2009: None				
(U)					
(U)	MAJOR THRUST: Investigate innovative technologies for space-based communication capabilities to ensure continued Air Force space dominance.	0.971	0.996	1.000	1.000
(U)	In FY 2006: Widened consideration of innovative methods for optical communications. Probed novel techniques for potential bandwidth efficient modulation to enhance satellite communications. Explored 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)	In FY 2008: Refine the details of the investigation that partially coherent laser beams are less disturbed by passage through turbulent atmospheres than their classically coherent counterparts. Pursue the design of solid state lasers which can emit such partially coherent beams. Continue to investigate the possibility that the long distance stability of polarization states can be exploited to communicate digitized messages.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2311 Information Sciences**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2009: Pursue extensive modeling and simulation of the performance of selected solid state partially coherent laser designs together with the propagation of partially coherent laser beams through surrogate turbulent media. Monitor the polarization states to verify the predicted long distance stability.				
(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.	4.184	4.827	5.411	5.705
(U)	In FY 2006: Conducted research on data fusion science to enable 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 RF/free-space optical paradigm and refined the parameters of other innovative technologies to attain ultra-fast, reliable information exchange. Conducted research on 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)	In FY 2008: Focus on integrating results in distributed navigation, geo-location, and interactive telemetry to improve the collecting and interpreting of battlespace information, with emphasis placed on dealing with diverse, changing warfare scenarios. 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.				
(U)	In FY 2009: Study navigation approaches such as "optical flow field" to improve understanding of the foundation for over-arching methodologies that integrate sensing data collected by distributed,				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2311 Information Sciences**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	inter-communicating networks of sensor resources. Continue to develop ultra-wide band transmission technology for hyper-spectral and other diverse data. 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.				
(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.	10.788	11.879	19.001	20.475
(U)	In FY 2006: Conducted research on information operations science techniques to proactively protect information intensive systems and networks. Developed information fusion science to provide deep, adaptive, expert decision support. Exploited quantum and bio-computing techniques and algorithms to allow enhanced tracking, recognition, and characterization to improve situational awareness, command and control, and security. Began 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)	In FY 2008: Significantly increase investigation of first principles of software system, network, and information system architectures including characteristic properties and metrics, and begin development of automatic software architecture analysis tools. Add research on brilliant software agents and other techniques for information operations, knowledge mining, and to improve situational awareness and command and control. Continue evolving information operations science techniques to exploit information intensive systems and networks. Further develop information fusion science to provide deep, adaptive, expert decision support.				
(U)	In FY 2009: Continue to increase emphasis on investigating first principles of software system architectures including characteristic properties and metrics and begin development of automatic				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2311 Information Sciences**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	software architecture analysis tools. Continue research on brilliant software agents and other techniques for information operations, knowledge mining, and to improve situational awareness and command and control. Continue to develop information operations science techniques to exploit information intensive systems and networks. Continue developing information fusion science to provide deep, adaptive, expert decision support.				
(U)					
(U)	CONGRESSIONAL ADD: Griffith Observatory's Planetarium	0.966	0.000	0.000	0.000
(U)	In FY 2006: Supported educational programming and exhibits that demonstrate the application of defense technology and research.				
(U)	In FY 2007: Not Applicable				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable				
(U)					
(U)	CONGRESSIONAL ADD: Network Information and Space Security Center	4.440	0.000	0.000	0.000
(U)	In FY 2006: Conducted fundamental multi-disciplinary scientific research associated with network information and space security efforts.				
(U)	In FY 2007: Not Applicable				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable				
(U)	Total Cost	29.653	26.900	25.412	27.180

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2311 Information Sciences**

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

(U) PE 0603410F, Space System Environmental Interactions Technology.

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.

This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE
February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
01 Basic Research	**0601102F Defense Research Sciences**	**2312 Biological Sciences**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2312 Biological Sciences	9.486	10.014	10.396	10.295	12.153	11.516	12.113	12.927	Continuing	TBD
Quantity of RDT&E Articles	0	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. Research in biophysical mechanisms will look to discover and understand basic biological mechanisms that could be used to either harden or repair bio-based devices or can utilize complex, impure biofuels for compact power. This will enable the Air Force to employ biologically based systems, either within or outside of a living cell, with optimum performance and extended lifetimes.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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 synthetic 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 hormetic mechanisms involved in the positive stimulatory (rather than the negative inhibitory) biological responses induced by low-doses of toxic agents and investigate the implications of such low-dose positive stimulation in inducing a protective state in tissue that is resistant to subsequent high-dose toxicity.	5.379	5.724	5.872	5.836
(U) In FY 2006: Refined biokinetics models used to predict the fuel constituent levels in tissues following dermal and pulmonary exposures to fuel mixtures. Applied methodologies for profiling and modeling the biomolecular responses induced by the interactions of directed energy and nano-energetic materials with biological systems. Utilized biocatalysis techniques for use in genetically engineering photosynthetic microbes to generate fuel-cell hydrogen from water. Explored the dose ranges and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2312 Biological Sciences**

(U) B. Accomplishments/Planned Program ($ in Millions) FY 2006 FY 2007 FY 2008 FY 2009

kinetics associated with the positive stimulatory or "hormetic" responses of biological systems exposed to very low-levels of 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) In FY 2008: Refine whole animal biokinetic models predicting tissue disposition of fuel components based on iterative experimental input derived from laboratory animal exposures and analyses. Begin to apply newly developed methodologies to acquire in vitro and in vivo data from biological systems exposed to nano-scale structures possessing varying physical and chemical properties. By using recently improved methodologies, begin the molecular profiling and characterization of biological systems responding to high and low doses of directed energy generated from laser and microwave sources. Continue bio-prospecting for hydrogen-generating microbes and begin bio-engineering and directed-evolution experiments aimed at enhancing the photosynthetic flow of electrons and protons to the hydrogen-generating enzyme. Continue to acquire genomic profiling data from various hormetic and non-hormetic response segments of radiation-exposed cells and begin bioinformatics analysis to identify specific genes or gene fingerprints that suggest a uniquely hormetic response.

(U) In FY 2009: Begin to integrate individual computational models characterizing multi-component fuel deposition in lung and absorption through skin into animal biokinetic models for predicting whole animal disposition of single fuel components. Continue to collect data from biological systems exposed to nano-materials and begin to develop a data base of responses for future predictive modeling studies based on physico-chemical properties of various nanostructures. Continue collecting directed energy dose-response data and begin bioinformatics analyses to identify unique biomolecular profiles responding to specific levels of radiant exposure. Continue bio-prospecting, bio-engineering and directed-evolution approaches to the generation of hydrogen fuel by photosynthetic microbes and begin metabolic engineering research to identify and eliminate pathways that drain unnecessary energy equivalents away from the hydrogen-generating apparatus. Continue genomic profiling and

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2312 Biological Sciences**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	bioinformatics analysis of hormetic and non-hormetic dose-response segments and begin to use comparative proteomics to validate any mechanistic conclusions deduced from genomic data.				
(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. Research in biophysical mechanisms will look to discover and understand basic biological mechanisms that could be used to either harden or repair bio-based devices or can utilize complex, impure biofuels for compact power.	4.107	4.290	4.524	4.459
(U)	In FY 2006: Investigated, evaluated, modeled, and mimicked biological processes and designs for future applications in near ambient temperature sensing devices. Probed and manipulated 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 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)	In FY 2008: Initiate work on manipulating materials to mimic the desirable properties found in skin for maintenance, self-healing, and repair. Continue to investigate 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. Continue investigations in extremophile research to access biosynthetic pathways and materials not achievable				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	with room temperature organisms. Continue work in biophysical mechanisms to discover and understand the basic underlying biological mechanism that could be used to either harden or repair bio-based devices or can utilize complex, impure biofuels for compact power.				
(U)	In FY 2009: Continue work on manipulating materials to mimic the desirable properties found in skin for maintenance, self-healing and repair. Continue to investigate 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. Continue investigations in extremophile research to access biosynthetic pathways and materials not achievable with room temperature organisms. Continue work in biophysical mechanisms to discover and understand the basic underlying biological mechanism that could be used to either harden or repair bio-based devices or can utilize complex, impure biofuels for compact power.				
(U)	Total Cost	9.486	10.014	10.396	10.295

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										

This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2312 Biological Sciences**

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
01 Basic Research	**0601102F Defense Research Sciences**	**2313 Human Performance**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2313 Human Performance	13.402	12.556	11.120	11.254	16.255	13.945	12.424	12.715	Continuing	TBD
Quantity of RDT&E Articles	0	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, including the flexible adaptation of Air Force systems to meet new adversarial challenges; 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 socio-cultural modeling, and chronobiology; and behavioral and physiological measures of fatigue.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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.	4.973	5.443	5.400	5.253

(U) In FY 2006: Conducted empirical research with mathematical and computational modeling in spatial audition, speech perception, and hearing protection. Further 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 consequences in the performance of an individual warfighter. Studied 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) In FY 2008: Continue empirical research with mathematical and computational modeling in spatial

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	audition, speech perception, and hearing protection. Prepare new understanding of speech recognition and acoustic noise for transition to hearing protection technologies. Exploit multi-sensory integration methods and novel biological sensing mechanisms. Continue to probe biophysical mechanisms responsible for fatigue, including models of sleep/wake dynamics. Shift emphasis from acute to chronic sleep deprivation, to predict specific consequences in the performance of individual warfighters. Refine models showing effects of ultrashort laser pulse on the eye (laser flash blindness).				
(U)	In FY 2009: Continue empirical research with mathematical and computational modeling in spatial audition, speech perception, and hearing protection for improved technologies in speech recognition, team communication, and hearing conservation. Begin to transition multi-sensory integration methods and novel biological sensing mechanisms. Continue to probe biophysical mechanisms responsible for fatigue. Continue shifting emphasis from acute to chronic sleep deprivation, to quantify performance changes in individual warfighters. Continue refining models of ultrashort laser pulse on the eye (laser flash blindness).				
(U)					
(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. Discover dynamic models of attitudes and beliefs that drive adaptive decision-making of interacting non-cooperative groups.	5.051	5.358	5.720	6.001
(U)	In FY 2006: Developed quantitative models and methods for improved understanding of individual and team information processing and decision making. Assessed mechanisms affecting training effectiveness for individuals and teams. Continued modeling relationships between individual skill differences and interactions with envisioned training. Continued 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.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**	PROJECT NUMBER AND TITLE **2313 Human Performance**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Continue to refine quantitative models of individual and team information processing and decision-making for application to systems for improving speed and accuracy of decisions 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 to enable human and machine collaboration. Continue exploring measures to avert/mitigate human error and optimize decision making under conditions of uncertainty and information overload. Increase cognitive process modeling to include socio-cultural influences in competitive or non-cooperative environments for successful airmen response to and prediction of adversary actions.				
(U)	In FY 2009: Continue to refine quantitative models of individual and team information processing and decision-making for application to systems for improving the speed and accuracy of decisions in 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 to enable true human and machine collaboration. Continue exploring measures to avert/mitigate human error and optimize decision making under conditions of uncertainty and information overload. Continue cognitive process modeling, including agent-based modeling and game theory, to include socio-cultural influences in competitive or non-cooperative environments for successful airmen response to and prediction of adversary actions.				
(U)					
(U)	CONGRESSIONAL ADD: Virtual Teleoperations for Unmanned Aerial Vehicles	3.378	1.755	0.000	0.000
(U)	In FY 2006: Supported 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: Continue research on virtual reality technology to allow a single operator to simultaneously monitor and control multiple unmanned aerial vehicles remotely.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	13.402	12.556	11.120	11.254

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602202F, Human Effectiveness Applied Research.										
(U) PE 0602702F, Command, Control, and Communication.										

This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
01 Basic Research	**0601102F Defense Research Sciences**	**4113 External Research Programs Interface**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4113	External Research Programs Interface	8.434	8.663	12.019	12.414	13.576	13.119	13.837	14.703	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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.	4.393	4.503	4.795	5.096

(U) In FY 2006: Provided centralized cooperation expertise and supported international technology liaison missions in order to identify and maintain awareness of foreign science and technology developments. Capitalized on foreign investments by influencing and acquiring world-class scientific research. Established and maintained access to technical briefs and publications on unique foreign research and research capabilities. 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 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 NATO-affiliated research institutes.

(U) In FY 2008: Continue to provide centralized cooperation expertise and support international technology

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	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 NATO-affiliated research institutes.				
(U)	In FY 2009: 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 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. Note: Increased funding in FY 2008 and out is due to emphasis on Scientific Advisory Board efforts.	4.041	4.160	7.224	7.318
(U)	In FY 2006: Supported 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 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)	In FY 2008: Continue to support science, mathematics, and engineering research and educational outreach programs at U.S. colleges and universities, including historically black colleges and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	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)	In FY 2009: 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)	Total Cost	8.434	8.663	12.019	12.414

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0601103D, University Research Initiative.										
(U)	PE 0602102F, Materials.										
(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										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

Technology.

(U) PE 0602602F, Conventional Munitions.

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

This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
01 Basic Research

PE NUMBER AND TITLE
0601103F University Research Initiatives

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	105.698	115.035	104.304	101.850	124.004	124.444	120.867	123.151	Continuing	TBD
5094 University Research Initiatives	105.698	115.035	104.304	101.850	124.004	124.444	120.867	123.151	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 2007, Congress added $4M for Single Chip Multi-Modal Nanosensors, $1.8M for High Assurance Software Engineering, $1M for High Temperature Hydrogen Energy Production, and $1.1M for Partnership in Innovative Preparation for Educators and Students. This program is in Budget Activity 1, Basic Science, because it funds scientific study and experimentation.

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

	FY 2006	FY 2007	FY 2008	FY 2009
(U) Previous President's Budget	108.757	107.571	107.931	117.225
(U) Current PBR/President's Budget	105.698	115.035	104.304	101.850
(U) Total Adjustments	-3.059			
(U) Congressional Program Reductions				
Congressional Rescissions	-0.003	-0.436		
Congressional Increases		7.900		
Reprogrammings				
SBIR/STTR Transfer	-3.056			

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5094	University Research Initiatives	105.698	115.035	104.304	101.850	124.004	124.444	120.867	123.151	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2007, Congress added $4M for Single Chip Multi-Modal Nanosensors, $1.8M for High Assurance Software Engineering, $1M for High Temperature Hydrogen Energy Production, and $1.1M for Partnership in Innovative Preparation for Educators and Students. This program is in Budget Activity 1, Basic Science, because it funds scientific study and experimentation.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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.	50.913	54.236	56.343	54.947

(U) In FY 2006: Funded competitive research awards at U.S. universities to focus on underpinning Air Force-related technologies usually not achievable through typical single investigator awards. Supported and recognized superior academic research through the Presidential Early Career Award for Scientists and Engineers (PECASE). Continued funding of multi-disciplinary programs begun in prior years.

(U) In FY 2007: 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. 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) In FY 2008: 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) In FY 2009: 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.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601103F University Research Initiatives**	PROJECT NUMBER AND TITLE **5094 University Research Initiatives**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)** 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)					
(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 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.	35.077	37.650	36.325	35.470
(U)	In FY 2006: 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. Continued to fund 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)	In FY 2008: 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 2009: 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.	14.630	15.500	11.636	11.433
(U)	In FY 2006: 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.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601103F University Research Initiatives**	PROJECT NUMBER AND TITLE **5094 University Research Initiatives**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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)	In FY 2008: 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 2009: 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	1.054	0.000	0.000	0.000
(U)	In FY 2006: Supported an Information Operations curriculum to educate graduates and undergraduates in the field of intelligence.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Bio/Nano Electronic Devices and Sensors	1.437	0.000	0.000	0.000
(U)	In FY 2006: Developed and demonstrated 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.				
(U)	In FY 2007: Not Applicable				
(U)	In FY 2008: Not Applicable				
(U)	In FY 2009: Not Applicable				
(U)					
(U)	CONGRESSIONAL ADD: High Assurance Software Engineering	1.629	1.743	0.000	0.000
(U)	In FY 2006: Conducted research in the security issues in information technology architectures and components. (Note: In FY 2006, it was called Secure and Assured Information Sharing)				
(U)	In FY 2007: Continue research to develop software for information security				
(U)	In FY 2008: Not Applicable				
(U)	In FY 2009: Not Applicable				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601103F University Research Initiatives**	PROJECT NUMBER AND TITLE **5094 University Research Initiatives**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)					
(U)	CONGRESSIONAL ADD: Military Logistics Readiness	0.958	0.000	0.000	0.000
(U)	In FY 2006: Supported the Air Force crew systems personnel protection program.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable				
(U)	In FY 2009: Not Applicable				
(U)					
(U)	CONGRESSIONAL ADD: Partnership in Innovative Preparation for Educators and Students (Note: In FY06, this add was in PE 61102F BPAC 2311 and called Network Information & Space Security)	0.000	1.065	0.000	0.000
(U)	In FY 2006: Not Applicable				
(U)	In FY 2007: Conduct multi-disciplinary research associated with information network for educators and students				
(U)	In FY 2008: Not Applicable				
(U)	In FY 2009: Not Applicable				
(U)					
(U)	CONGRESSIONAL ADD: Single Chip Multi-Modal Nanosensors	0.000	3.873	0.000	0.000
(U)	In FY 2006: Not Applicable				
(U)	In FY 2007: Conduct research to develop single chip sensors for the detection of chemical and biological agents				
(U)	In FY 2008: Not Applicable				
(U)	In FY 2009: Not Applicable				
(U)					
(U)	CONGRESSIONAL ADD: High Temperature Hydrogen Energy Production	0.000	0.968	0.000	0.000
(U)	In FY 2006: Not Applicable				
(U)	In FY 2007: Conduct research to develop methods for hydrogen production				
(U)	In FY 2008: Not Applicable				
(U)	In FY 2009: Not Applicable				
(U)	Total Cost	105.698	115.035	104.304	101.850

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **01 Basic Research**	PE NUMBER AND TITLE **0601103F University Research Initiatives**	PROJECT NUMBER AND TITLE **5094 University Research Initiatives**

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0601102F, Defense Research Sciences										

This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

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

Exhibit R-2, RDT&E Budget Item Justification

DATE: **February 2007**

BUDGET ACTIVITY
01 Basic Research

PE NUMBER AND TITLE
0601108F High Energy Laser Research Initiatives

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	12.072	12.356	12.636	13.735	14.079	14.299	14.581	14.883	Continuing	TBD
5097	High Energy Laser Research Initiatves	12.072	12.356	12.636	13.735	14.079	14.299	14.581	14.883	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. 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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	12.414	12.403	12.524	13.583
(U)	Current PBR/President's Budget	12.072	12.356	12.636	13.735
(U)	Total Adjustments	-0.342			
(U)	Congressional Program Reductions				
	Congressional Rescissions		-0.047		
	Congressional Increases				
	Reprogrammings				
	SBIR/STTR Transfer	-0.342			

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601108F High Energy Laser Research Initiatives

Under Development.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
01 Basic Research	**0601108F High Energy Laser Research Initiatives**	**5097 High Energy Laser Research Initiatves**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5097	High Energy Laser Research Initiatves	12.072	12.356	12.636	13.735	14.079	14.299	14.581	14.883	Continuing	TBD
	Quantity of RDT&E Articles	0	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. 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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Improve the fundamental understanding of high-power laser sources, to include solid-state, free electron, and gas laser technologies.	7.054	7.450	7.578	8.563
(U) In FY 2006: Initiated fiber laser research focused on single aperture scaling single-mode fibers, and organization of multiple fibers. Initiated research to understand optically-pumped atomic and molecular gas lasers. Conducted research in chemical processes and chemical reactions for closed-cycle chemical lasers. Conducted free electron laser research on high-damage resonator optics, advanced optical cavity designs for high power, and scaling methodology for megawatt-class power levels. Conducted research in solid-state laser materials with large fluorescence lifetime and cross-section, and the ability to operate at high temperatures.				
(U) In FY 2007: Complete research on closed-cycle chemical, free electron, and solid state laser initiatives. Conduct fiber laser research focused on single aperture scaling single-mode fibers, and organization of multiple fibers. Conduct fundamental research of optically-pumped atomic and molecular gas lasers. Conduct a multi-disciplinary research institute (MRI) call for innovative research related to gas, free electron, and solid state laser topics.				
(U) In FY 2008: Conduct fiber laser research focused on single aperture scaling single-mode fibers, and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	organization of multiple fibers. Conduct fundamental research of optically-pumped atomic and molecular gas lasers. Initiate research on awarded topics in gas, free electron, and solid state laser technologies.				
(U)	In FY 2009: Conduct fiber laser research focused on single aperture scaling single-mode fibers, and organization of multiple fibers. Conduct fundamental research of optically-pumped atomic and molecular gas lasers. Conduct research on awarded topics in gas, free electron, and solid state laser technologies.				
(U)					
(U)	MAJOR THRUST: Improve the fundamental understanding of beam control technologies as they relate to high power laser applications. Conduct research in atmospheric characterization and beam control component technology.	2.271	2.493	2.559	2.662
(U)	In FY 2006: Improved negative thermal expansion optical coating materials to match zero expansion substrates, and measured thermal and strain responses of these coatings. Conducted research on improved theoretical and computational atmospheric propagation effects, advanced wavefront sensing, and thermal blooming effects. Discontinued lightweight optics research.				
(U)	in FY 2007: Improve negative thermal expansion optical coating materials to match zero expansion substrates, and measured thermal and strain responses of these coatings. Complete research on improved theoretical and computational atmospheric propagation effects, advanced wavefront sensing, and thermal blooming effects. Conduct an MRI call for innovative research related to improved beam control technology and techniques.				
(U)	In FY 2008: Complete negative thermal expansion research. Initiate research on awarded topics for improved beam control technologies and techniques.				
(U)	In FY 2009: Conduct research on awarded topics for improved beam control technologies and techniques.				
(U)					
(U)	MAJOR THRUST: Evaluate high-fidelity engineering models for incorporation into the HEL toolkit.	1.520	1.765	1.794	1.700
(U)	In FY 2006: Began to merge the developed models into a common architecture through verification and validation techniques. Conducted mission-level HEL engagement scenarios and wargame HEL concepts.				
(U)	In FY 2007: Merge the developed models into a common architecture through verification and validation techniques. Conduct mission-level HEL engagement scenarios and wargame HEL concepts.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Merge the developed models into a common architecture through verification and validation techniques. Conduct mission-level HEL engagement scenarios and wargame HEL concepts.				
(U)	In FY 2009: Merge the developed models into a common architecture, through verification and validation techniques. Conduct mission-level HEL engagement scenarios and wargame HEL concepts.				
(U)					
(U)	MAJOR THRUST: Fund educational grants intended to simulate interest in HEL among students.	0.556	0.648	0.705	0.810
(U)	In FY 2006: Provided scholarships and internships to support to college students obtaining HEL degrees. Provided support to K-12 school programs to stimulate science and math studies, with an emphasis on lasers and optics. Funded publication of journals and continuing education for professionals in the HEL field. Initiated a Service Academy grant program to stimulate HEL studies among military cadets.				
(U)	In FY 2007: Provide scholarships and internships to support to college students obtaining HEL degrees. Provide grants to Service Academies to stimulate HEL studies among military cadets. Provide support to K-12 school programs to stimulate science and math studies, with an emphasis on lasers and optics. Fund publication of journals and continuing education for professionals in the HEL field.				
(U)	In FY 2008: Provide scholarships and internships to support to college students obtaining HEL degrees. Provide grants to Service Academies to stimulate HEL studies among military cadets. Provide support to K-12 school programs to stimulate science and math studies, with an emphasis on lasers and optics. Fund publication of journals and continuing education for professionals in the HEL field.				
(U)	In FY 2009: Provide scholarships and internships to support to college students obtaining HEL degrees. Provide grants to Service Academies to stimulate HEL studies among military cadets. Provide support to K-12 school programs to stimulate science and math studies, with an emphasis on lasers and optics. Fund publication of journals and continuing education for professionals in the HEL field.				
(U)					
(U)	CONGRESSIONAL ADD: Landscape Operational and Knowledge-based Characterization.	0.671	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Landscape Operational and Knowledge-based Characterization.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	12.072	12.356	12.636	13.735

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 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										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)**

duplication.

(U) **D. Acquisition Strategy**

Not Applicable.

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Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2007

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602015F Medical Development**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	0.000	23.810	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5244	Diabetes Research	0.000	23.810	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: Funds for the FY 2007 Congressionally-directed National Diabetes Model Program in the amount of $22.0 million, Retinal Eye Scan for Pilots in the amount of $0.5 million, and Assessment and Demonstration Center for USAF Surgeon General in the amount of $1.4 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 2007 Congressionally-directed National Diabetes Model Program in the amount of $22.0 million, Retinal Eye Scan for Pilots in the amount of $0.5 million, and Assessment and Demonstration Center for USAF Surgeon General in the amount of $1.4 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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	18.434	0.000	0.000	0.000
(U)	Current PBR/President's Budget	0.000	23.810	0.000	0.000
(U)	Total Adjustments	-18.434			
(U)	Congressional Program Reductions				
	Congressional Rescissions		-0.090		
	Congressional Increases		23.900		
	Reprogrammings	-18.434			
	SBIR/STTR Transfer				

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE
February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602015F Medical Development**	**5244 Diabetes Research**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5244 Diabetes Research	0.000	23.810	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	0		

Note: Funds for the FY 2007 Congressionally-directed National Diabetes Model Program in the amount of $22.0 million, Retinal Eye Scan for Pilots in the amount of $0.5 million, and Assessment and Demonstration Center for USAF Surgeon General in the amount of $1.4 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 2007 Congressionally-directed National Diabetes Model Program in the amount of $22.0 million, Retinal Eye Scan for Pilots in the amount of $0.5 million, and Assessment and Demonstration Center for USAF Surgeon General in the amount of $1.4 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 2006	FY 2007	FY 2008	FY 2009
(U)	CONGRESSIONAL ADD: National Diabetes Model Program.	0.000	21.917	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for National Diabetes Model Program.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Assessment and Demonstration Center for the USAF Surgeon General.	0.000	1.395	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Assessment and Demonstration Center for the USAF Surgeon General.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Retinal Eye Scan for Pilots.	0.000	0.498	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Retinal Eye Scan for Pilots.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	0.000	23.810	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602015F Medical Development**	PROJECT NUMBER AND TITLE **5244 Diabetes Research**

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost

(U) Related Activities:
Not Applicable.

(U) D. Acquisition Strategy
Not Applicable.

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Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2007

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602102F Materials

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	114.877	153.293	122.794	110.412	132.340	128.275	122.736	120.919	Continuing	TBD
01SP	Space Materials Development	0.000	26.511	34.496	32.254	38.750	39.456	38.660	39.217	Continuing	TBD
4347	Materials for Structures, Propulsion, and Subsystems	73.687	72.689	46.921	38.459	50.459	48.142	43.843	44.954	Continuing	TBD
4348	Materials for Electronics, Optics, and Survivability	18.880	28.710	21.780	20.116	21.834	19.217	18.315	14.267	Continuing	TBD
4349	Materials Technology for Sustainment	16.455	19.643	17.017	17.259	18.570	18.705	19.105	19.596	Continuing	TBD
4915	Deployed Air Base Technology	5.855	5.740	2.580	2.324	2.727	2.755	2.813	2.885	Continuing	TBD

Note: In FY 2007, Project 01SP, Space Materials Development, efforts 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 2007 Congressionally-directed Accelerated Insertion of Advanced Materials and Certification for Military Aircraft Structure Material Substitution and Repair in the amount of $1.1 million are in the process of being moved to PE 0602102F, Materials, from PE 0702207F, Depot Maintenance, 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 2007 Congress added $1.0 million for Secure Coating Systems Technology, $1.0 million for NanoMaterials Commercialization Center, $1.0 million for Chrome Free Environmentally Friendly Corrosion Protection for Aircraft, $1.0 million for Integral Fuel Tank Protective Coating System, $1.3 million for Accelerated Insertion of Advanced Materials for Materials Substitution and Repair - National Institute for Aviation Research, $2.9 million for Wide Bandgap Materials Integration for Power Electronic, Sensor, and Optical Devices, $1.4 million for Power Electronics Reliability, $1.4 million for Fabrication and Processing of Adaptive Optics and Optical Materials, $2.0 million for Electronic Type-specific Buckytubes for Next Generation Defense Electronics, $2.0 million for Blast Resistant Panels for Buildings, Shelters, and Vehicles, $1.0 million for High Temperature Aerogel materials for Global Strike Vehicles, $1.0 million for Hybrid Materials Integration, $1.0 million for Domestic Titanium Powder Manufacturing Initiative, $1.0 million for Quantum Wire Program for Defense, $1.4 million for Consortium for Nanomaterials for Aerospace commerce and Technology (CONTACT), $2.3 million for ONAMI Safer Nanomaterials and Nanomanufacturing, $2.0 million for domestic High Modulus PAN Carbon Fiber Qualification Initiative, $3.3 million for Advanced Aerospace Manufacturing Technologies, $1.0 million for Advanced Materials Deposition for Semiconductor Nanostructure, $1.0 million for Advanced Materials Development for Force Protection, $5.5 million for Air Force Minority Leader Program, $1.3 million for Durable hybrid Coatings for Aircraft Systems, $1.0 million for Engineered Optical Materials for Quantum Cryptography, $1.1 million for Fire and Blast Resistant Materials for Force Protection, $2.9 million for Advanced Coatings

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**

Technologies for JSF and F-22 Survivability, and $1.0 million for Enabling Polymeric Materials for Three-Dimensional (3D) Microdevice Construction. 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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	121.451	111.073	116.564	118.397
(U)	Current PBR/President's Budget	114.877	153.293	122.794	110.412
(U)	Total Adjustments	-6.574			
(U)	Congressional Program Reductions				
	Congressional Rescissions	0.053	-0.580		
	Congressional Increases		38.900		
	Reprogrammings	-4.645	3.900		
	SBIR/STTR Transfer	-1.982			

(U) Significant Program Changes:

In FY 2007, Project 01SP, Space Materials Development, efforts 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 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	0602102F Materials	01SP Space Materials Development

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
01SP Space Materials Development	0.000	26.511	34.496	32.254	38.750	39.456	38.660	39.217	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2007, Project 01SP, Space Materials Development, efforts 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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop materials and processes to dramatically improve performance, durability, and cost of rocket propulsion systems.	0.000	11.500	3.634	3.591

(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. Analyze 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) In FY 2008: Optimize candidate materials and 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. Develop processes to produce full scale test components that can be tested in rocket engine environment. Analyze material

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	behavior in rocket combustion environment. Construct pervasive materials requirements to meet advanced performance and cost goals. Validate and demonstrate materials, test sub-elements, and sub-components for thrust chambers, nozzles, and catalysts.				
(U)	In FY 2009: Down select the highest payoff materials and processes for high-speed turbopump housings and turbines, ducts, valves, solid rocket casings, insulation, and nozzle throats and develop mechanical property databases for design consideration. Optimize processes to produce full scale test components that can be tested in rocket engine environment. Analyze material behavior in rocket combustion environment. Focus development plans on pervasive materials requirements to meet advanced performance and cost goals. Transition 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	10.908	20.201	16.556
(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. Analyze 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. Evaluate candidate space materials and collect critical data to facilitate materials transition.				
(U)	In FY 2008: Develop and validate test methodology and evaluation techniques for processing, durability, and life prediction of thermal protection system applications for selected thin gage metallic materials. Develop scale-up processing and integration techniques that will provide the capability for fabrication of complex geometries and built-up structures. Explore materials options for high-temperature protection systems for expendable and reusable high-speed vehicle applications in collaboration with industry. Transition data on oxidation protection schemes for carbon-carbon				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **01SP Space Materials Development**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	materials. Demonstrate benefits of nano-tailored composite materials for multifunctional space applications. Validate wear-resistant materials, lubricants, and Micro-Electro-Mechanical System (MEMS) devices for moving mechanical assemblies on spacecraft against environment specific criteria. Evaluate candidate space materials and collect critical data to facilitate materials transition.				
(U)	In FY 2009: Transition initial test methodology and evaluation techniques for processing, durability, and life prediction of thermal protection system applications for component operation in robust high-temperature, long-duration cruise, or access to space environments. Continue materials processing development and demonstrate structural integration into sub-scale components for testing in relative environments. Develop materials candidates for high-temperature protection systems for expendable and reusable high-speed vehicle applications in collaboration with industry. Continue to validate wear-resistant materials, lubricants, and Micro-Electro-Mechanical System (MEMS) devices for moving mechanical assemblies on spacecraft against environment specific criteria. 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, situational awareness systems, and space-based communications/computing.	0.000	4.103	10.661	12.107
(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. 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)	In FY 2008: Demonstrate processes and process control methodology to enable very long wavelength infrared detection. Develop materials processing technology for short wavelength detectors that will provide capability of staring focal plane arrays with more than 4 million pixels (2k x 2k). Develop nano-photonic materials for high performance optoelectronic devices for optical communications and system control architectures. Demonstrate materials and materials process technologies for application in combined optical and radio frequency communication system apertures.				
(U)	In FY 2009: Transition processes and process control methodology to enable very long wavelength infrared focal plane arrays. Demonstrate processing technology for short wavelength infrared detectors				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **01SP Space Materials Development**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	by hybridization and characterization of 2k x 2k format focal plane array. Demonstrate nano-photonic materials for high performance optoelectronic devices for optical communications and system control architectures. Transition suitable materials and materials process technologies for application in combined optical and radio frequency communication system apertures.				
(U)	Total Cost	0.000	26.511	34.496	32.254

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0602500F, Multi-Disciplinary Space Technology.										
(U)	This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602102F Materials**	**4347 Materials for Structures, Propulsion, and Subsystems**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4347	Materials for Structures, Propulsion, and Subsystems	73.687	72.689	46.921	38.459	50.459	48.142	43.843	44.954	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(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 2006	FY 2007	FY 2008	FY 2009
(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.	3.994	3.833	3.191	2.398
(U) In FY 2006: Designed, fabricated, and tested advanced ceramic composite coupons and sub-elements for demonstration of durability. Expanded the ceramic composite life prediction model to account for complex component shapes and apply to complex turbine component shapes. Developed material/component acceptance criteria. Validated advanced weaving and design methodology of integrally cooled ceramic composites by designing, fabricating, and testing an annular trapped vortex combustor. Scaled 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 service life conditions. Incorporate environmental degradation analysis into the ceramic composite life prediction model to address time dependent degradation associated with environmental exposure. Demonstrate the severe environment durability of advanced ceramic composite systems with advanced interfaces via mechanical testing.				
(U) In FY 2008: Demonstrate advanced ceramic composite performance through testing under real and simulated engine service life conditions. Demonstrate environmental degradation analysis in the				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	ceramic composite life prediction model. Validate the severe environment durability of advanced ceramic composite systems with advanced interfaces via mechanical testing.				
(U)	In FY 2009: Validate advanced ceramic composite performance through testing under real and simulated engine service life conditions. Validate the life prediction model to address time dependent degradation associated with environmental exposure. Validate 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. Develop nanoscale architectures to address advanced Air Force conducting, structural, and electromechanical applications. Note: This effort includes Congressional Add funding of $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, $1.5 million for Innovative Process for Continuous Fabrication of Carbon Nanotube Membranes, $11.0 million for Strategic Partnership for Research in Nanotechnology, $1.0 million for Nano Organic Polymer Materials: Dynamic Camouflage, and $1.0 million for Fully-Integrated Solar-Powered Interior Lighting) and $5.7 million in FY 2007 ($2.3 million for ONAMI Safer Nanomaterials and Nanomanufacturing, $1.4 million for Consortium for Nanomaterials for Aerospace Commerce and Technology (CONTACT), $1.0 million for Advanced Materials Development for Force Protection, and $1.0 million for Enabling Polymeric Materials for Three-Dimensional (3D) Microdevice Construction).	20.360	11.312	6.364	5.869
(U)	In FY 2006: Developed second-generation two photon absorbing (TPA) materials for night vision goggle and optical limiting applications. Investigated use of photonic crystals to enhance second- and third-order nonlinear optical properties for use in optical limiting applications. Demonstrated improved life for Air Force aircraft tires by incorporation of nanostructured polymeric materials. Validated aromatic hyperbranched polymers as viscosity-lowering additives for structural component manufacture via solvent-free processes. Investigated 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. Developed adaptive (shape memory and actuator) materials based on polymer nanocomposites for adaptive aircraft structures, wings, fins, antennas, and mirrors. Scaled up improved polymer proton exchange membranes for high efficiency, long life, lightweight, fuel				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	cell applications. Demonstrated polymer photovoltaic materials for high efficiency, long life, lightweight, solar cell applications.				
(U)	In FY 2007: 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)	In FY 2008: Deliver second-generation TPA materials for night vision goggle evaluation. Transition photonic crystals for super prism applications. Transition aromatic hyperbranched polymers for structural component manufacture via resin transfer molding processes. Develop organic-inorganic metamaterials for Air Force electromagnetic and photonic applications for reduced aperture size, conformal radar, and antenna systems. Transition organic-inorganic nanostructured materials for lightning strike resistant refueling boom. Develop electromagnetic interference (EMI) and high power microwave shielding for electronics hardening. Develop adaptive (shape memory and actuator) materials based on polymer nanocomposites for adaptive aircraft structures, wings, fins, antennas, and mirrors. Develop lightweight, low-cost photovoltaics for uninhabited air vehicle applications.				
(U)	In FY 2009: Develop organic-inorganic metamaterials for Air Force electromagnetic and photonic applications for reduced aperture size, conformal radar, and antenna systems. Develop EMI and high power microwave shielding for electronics hardening. Develop adaptive (shape memory and actuator) materials based on polymer nanocomposites for adaptive aircraft structures, wings, fins, antennas, and mirrors. Develop lightweight low-cost photovoltaics for uninhabited air vehicle 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 $4.4 million in FY 2006 ($1.0 million for Advanced Manufacturing Technologies for Metals, Composites,	18.524	21.428	15.737	11.476

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Materials, $2.0 million for Domestic Titanium Powder Manufacturing Initiative, and $1.4 million for Computational Tools for Materials Development) and $4.3 million in FY 2007 ($1.0 million for Domestic Titanium Powder Manufacturing Initiative and $3.3 million for Advanced Aerospace Manufacturing Technologies).				
(U)	In FY 2006: Demonstrated reliable life extension capability for turbine engine rotors. Explored materials-damage predictive approaches for engine health determination and life extension capability. Explored advanced metallic materials for enhanced performance propulsion for air platforms with an emphasis on higher temperature capability. Explored computational methods supporting development and processing to reduce costs to accelerate insertion of advanced metals into Air Force systems. Identified 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. Explore 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)	In FY 2008: Develop materials-damage predictive approaches for engine health determination and life extension capability. Develop advanced metallic materials for enhanced performance propulsion for air platforms with an emphasis on higher temperature capability. Validate computational methods supporting development and processing to reduce costs to accelerate insertion of advanced metals into Air Force systems.				
(U)	In FY 2009: Validate materials-damage predictive approaches for engine health determination and life extension capability. Develop and validate advanced metallic materials for enhanced performance propulsion for air platforms with an emphasis on higher temperature capability. Transition computational methods supporting development and processing to reduce costs to accelerate insertion of advanced metals into Air Force systems.				
(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 $3.25 million in FY	12.829	13.775	8.770	7.472

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4347 Materials for Structures, Propulsion, and Subsystems**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	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) and $4.0 million in FY 2007 ($2.0 million for Domestic High Modulus PAN Carbon Fiber Qualification Initiative, $1.0 million for High Temperature Aerogel Materials for Global Strike Vehicles, and $1.0 million for Hybrid Materials Integration).				
(U)	In FY 2006: Developed life prediction capabilities for high temperature turbine engine and airframe hot structures. Demonstrated high temperature organic matrix composites onto relevant DoD platforms. Investigated and assessed future requirements for material development as applied to next generation high-speed vehicle applications. Developed materials and processes for nanotailored composites with multifunctional capabilities. Initiated nanomaterial modeling efforts. Demonstrated 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. Demonstrate high temperature organic matrix composites onto relevant DoD platforms. Initiate new material development and affordable processing for space and high-speed vehicle applications. Develop new materials and processes for nanotailored composites with multifunctional capabilities. Continue nanomaterial modeling and technology efforts. Develop and demonstrate advanced material concepts and processes for thermal management applications.				
(U)	In FY 2008: Continue demonstration of life prediction tools for engine and airframe applications. Transition high temperature organic matrix composites. Downselect and optimize most promising new material systems for space and high speed vehicle applications. Demonstrate the multifunctional payoffs of nanotailored composite materials for aerospace platform applications. Develop and demonstrate nanomaterials modeling and technology with an emphasis on accelerating the insertion and transition of this class of materials. Validate advanced composite material concepts and processes for specific weapon system needs.				
(U)	In FY 2009: Validate benefits of life prediction tools for engine and airframe applications. Demonstrate improved performance of new material systems for space and high-speed vehicle applications. Integrate the developed models into commercial and industry tools. Transition advanced material concepts and processes to weapon and air vehicle platforms.				
(U)					
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop nonstructural materials for fluids, lubricants,	11.875	15.865	6.759	5.544

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

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 $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) and $7.2 million in FY 2007 ($1.3 million for Durable Hybrid Coatings for Aircraft Systems, $1.0 million for Chrome Free Environmentally Friendly Corrosion Protection for Aircraft, $1.0 million for Secure Coating Systems Technology, $1.0 million for Integral Fuel Tank Protective Coating System, and $2.9 million for Advanced Coating Technologies for JSF and F-22 Survivability).

(U) In FY 2006: Evaluated candidate materials for use in electrostatic discharge control gap treatments. Validated the advanced analytical models that will be used to predict the optical properties of specialty coatings based on measured data. Demonstrated non-chromate surface treatments via flight test. Developed technologies for environmentally friendly corrosion protection systems with a 30-year life expectancy. Developed nanostructured multifunctional coatings to control friction and wear in extreme environments. Tested 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. 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) In FY 2008: Transition candidate gap treatment materials on low observable air vehicles. Demonstrate the analytical models that will be used to predict the optical properties of specialty coatings based on measured data. Transition the non-chromate surface treatments for aircraft corrosion protection systems. Validate chrome-free primer for corrosion protection systems with a 30-year life expectancy. Demonstrate improved low friction wear multifunctional coatings on engineering components. Develop and optimize surface treatment candidates for friction, stiction, and wear control in micro devices.

(U) In FY 2009: Integrate the analytical models into the coatings development applications. Demonstrate chrome-free primer for corrosion protection systems with a 30-year life expectancy. Transition improved low friction wear multifunctional coatings on engineering components. Demonstrate surface treatment candidates for friction, stiction, and wear control in micro devices.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4347 Materials for Structures, Propulsion, and Subsystems**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)					
(U)	MAJOR THRUST: Develop nanomaterials science and technology in the areas of nanoenergetics to provide nano-reactive materials, additives, coated powders and laminates for munitions and propulsion with reduced size and higher lethality. Note: In FY 2008, this major thrust pulls together existing technologies from across the Air Force Research Laboratory to create an integrated nanoenergetics effort.	0.000	0.000	6.100	5.700
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Investigate large-scale synthesis and characterization of energetic nanomaterials to provide stable, triggerable, nanoscale energetic materials for enhanced energy release munitions and access to space. Discover and design unconventional nanomaterial behavior with regard to energy release via robust modeling and simulation. Investigate the transport and compartmentalization of nanoparticles within the environment. Develop microstructural characterization tools to provide robust processing-performance correlations of nanoenergetic systems. Investigate multi-component, structured nanoparticle catalyses as controlled release agents for enhancing stability and storage as well as providing enhanced ignition for high efficiency air-breathing propulsion.				
(U)	In FY 2009: Develop large-scale synthesis and characterization of energetic nanomaterials to provide stable, triggerable, nanoscale energetic materials for enhanced energy release munitions, high efficiency air-breathing propulsion, and access to space. Establish modeling and simulation tools to support nanoenergetics development. Analyze the transport and compartmentalization of nanoparticles being investigated as nanoenergetics to evaluate potential environmental impact. Develop microstructural characterization tools to provide robust processing-performance correlations of nanoenergetic systems. Investigate multi-component, structured nanoparticle catalyses as controlled release agents for enhancing stability and storage as well as providing enhanced ignition.				
(U)					
(U)	CONGRESSIONAL ADD: Minority LEADERS Research Program.	1.744	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Minority LEADERS Research Program.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4347 Materials for Structures, Propulsion, and Subsystems**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	CONGRESSIONAL ADD: Air Force Minority Leader Program.	3.392	5.480	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Air Force Minority Leader Program.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Air Force Minority Leader Program.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: NanoMaterials Commercialization Center.	0.969	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Nanomaterials Commercialization Center of Pennsylvania.				
(U)	In FY 2007: Conduct Congressionally-directed effort for NanoMaterials Commercialization Center.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	73.687	72.689	46.921	38.459

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0602500F, Multi-Disciplinary Space Technology.										
(U)	PE 0603112F, Advanced Materials for Weapon Systems.										
(U)	PE 0603211F, Aerospace Technology Dev/Demo.										
(U)	PE 0603216F, Aerospace Propulsion and Power Technology.										
(U)	This project has been coordinated through the Reliance 21 process to										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)**

harmonize efforts and
eliminate duplication.

(U) **D. Acquisition Strategy**

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602102F Materials**	**4348 Materials for Electronics, Optics, and Survivability**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4348	Materials for Electronics, Optics, and Survivability	18.880	28.710	21.780	20.116	21.834	19.217	18.315	14.267	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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.	0.651	1.317	1.731	1.533

(U) In FY 2006: Provided prototype growth, characterization, and analyses of potential IR materials systems to determine unique properties of interest to Air Force users. Developed the process control to enable ordered growth of two-dimensional, abrupt compositional interfaces in multiple wavelength materials. Validated 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. Explored 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.

(U) In FY 2008: Explore and validate suitable materials and structures for innovative IR materials in order to assess appropriateness for Air Force IR detection applications. Design and demonstrate IR materials systems capable of responses to more than two discrete wavelengths. Assess feasibility of further

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	research and utility of three-dimensional material growth to exploit unique detection properties of complex IR materials. Develop promising materials growth technologies for nano-scale IR detection materials. Develop epitaxial materials and devices fabricated for high power applications. Investigate materials to enable development of design capabilities. Improve materials matching between device and substrates to enable higher power efficiency, better reliability, and increased power density to enable power dense devices.				
(U)	In FY 2009: Develop materials and transition strategies for innovative IR materials while continuing to exploit newly emerging material concepts. Validate and optimize IR materials systems capable of responses to more than two discrete wavelengths. Develop candidate materials for three-dimensional growth to exploit unique detection properties of complex IR materials. Develop promising materials growth technologies for nano-scale IR detection materials. Demonstrate epitaxial materials device and substrate improvements. Develop design capability, leveraging new materials and substrates. Develop tools and methodologies that address the physics of failure for power dense devices.				
(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 merge into the survivability thrust below.	1.726	0.000	0.000	0.000
(U)	In FY 2006: Developed photorefractive materials for passive protection applications and developed device concepts that utilize photorefractive materials. Optimized the performance of high optical density, multiple-wavelength switchable filter technology for Air Force applications.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate enabling materials technologies to enhance the safety, survivability, and mission effectiveness of aircrews, sensors, viewing systems, and related assets. Note: In FY 2007, efforts from the previous survivability thrust merge into this major thrust.	4.765	8.470	9.782	8.677
(U)	In FY 2006: Characterized 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4348 Materials for Electronics, Optics, and Survivability**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	applications. Incorporate switchable filter technology into device concepts for eye and sensor system protection.				
(U)	In FY 2008: Demonstrate optimized nonlinear optical limiter materials for damage protection of eyes and sensor systems. Validate photorefractive materials properties for Air Force passive protection applications. Develop devices using switchable filter technology into eye and sensor system protection concepts.				
(U)	In FY 2009: Develop nonlinear optical limiter materials into device concepts for damage protection of eyes and sensor systems. Develop photorefractive materials into device concepts for Air Force passive protection applications. Demonstrate devices using switchable filter technology into eye and sensor system protection concepts.				
(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 $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) and $2.4 million in FY 2007 ($1.4 million for Power Electronics Reliability and $1.0 million for Advanced Materials Deposition for Semiconductor).	10.672	10.654	8.283	7.988
(U)	In FY 2006: Demonstrated scale-up of materials and materials processes for power control systems, advanced radar, and electronic countermeasures. Developed 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. Demonstrated scale-up of materials and materials processes to provide presently unattainable performance for power control systems, advanced radar, and electronic countermeasures. Developed 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. Developed materials and materials process technologies for Terahertz components supporting order of magnitude improvement in speed for Air Force sensor and communication systems. Identified most promising materials approaches for application to initial prototype evaluation.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4348 Materials for Electronics, Optics, and Survivability**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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. 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)	In FY 2008: Explore materials impact on device reliability for power control systems, advanced radar, and electronic countermeasures application. Demonstrate the capabilities of advanced materials process technologies as well as investigate the reliability of materials as applied to ultra-lightweight, ultra-high-power aircraft electrical generators enabling airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft. Demonstrate performance of candidate materials for use in Terahertz components, supporting high speed communications and advanced sensors.				
(U)	In FY 2009: Optimize materials properties for enhanced device reliability. Assess the reliability of materials for ultra-lightweight, ultra-high-power aircraft electrical generator applications, enabling airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft. Demonstrate performance of candidate materials for use in Terahertz components, supporting high speed communications and advanced sensors.				
(U)					
(U)	MAJOR THRUST: Develop enabling and foundational biotechnologies for the areas of guidance and control, rapid tagging, tracking, and identification of targets, and bio-integrated electronics and sensing for continued Air Force dominance. Note: In FY 2008, this major thrust pulls together existing technologies from across the Air Force Research Laboratory to create an integrated biotechnologies effort for taggants.	0.000	0.000	1.984	1.918
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Investigate use of biological/nanomaterial-based taggants for the detection and identification of CBRNE targets at a distance using hybrid constructs. Assess effectiveness of CBRNE destruction using taggants in counterproliferation operations. Neutralize biological and chemical agents				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	with the inherent and supplementary properties of the taggant nanoparticles. Develop active and passive polymer encapsulation technologies for taggant materials.				
(U)	In FY 2009: Develop new biological/nanomaterial hybrids for the detection and identification of CBRNE agents. Analyze efficacy data of using taggants to destroy CBRNE agents. Incorporate taggants into a variety of media (polymers, paints) for optimal and mission-specific dispersal. Model dispersion properties of polymer-encapsulated taggants for optimal release and coverage.				
(U)					
(U)	CONGRESSIONAL ADD: Engineered Optical Materials for High Energy Laser Development.	1.066	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Engineered Optical Materials for High Energy Laser Development.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Engineered Optical Materials for Quantum Cryptography.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Engineered Optical Materials for Quantum Cryptography.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Electronic Type-specific Buckytubes for Next Generation Defense Electronics.	0.000	1.993	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Electronic Type-specific Buckytubes for Next Generation Defense Electronics.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Fabrication and Processing of Adaptive Optics and Optical Materials.	0.000	1.395	0.000	0.000
(U)	In FY 2006: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4348 Materials for Electronics, Optics, and Survivability**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2007: Conduct Congressionally-directed effort for Fabrication and Processing of Adaptive Optics and Optical Materials.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Quantum Wire Program for Defense.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Quantum Wire Program for Defense.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Wide Bandgap Materials Integration for Power Electronic, Sensor, and Optical Devices.	0.000	2.889	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Wide Bandgap Materials Integration for Power Electronic, Sensor, and Optical Devices.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	18.880	28.710	21.780	20.116

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0602500F, Multi-Disciplinary Space Technology.										
(U)	PE 0603112F, Advanced Materials for Weapon Systems.										
(U)	PE 0602202F, Human Effectiveness Applied										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4348 Materials for Electronics, Optics, and Survivability**

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

Research.

(U) PE 0602204F, Aerospace Sensors.

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

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

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE
February 2007

BUDGET ACTIVITY
02 Applied Research

PE NUMBER AND TITLE
0602102F Materials

PROJECT NUMBER AND TITLE
4349 Materials Technology for Sustainment

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4349	Materials Technology for Sustainment	16.455	19.643	17.017	17.259	18.570	18.705	19.105	19.596	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: Funds for the FY 2007 Congressionally-directed Accelerated Insertion of Advanced Materials and Certification for Military Aircraft Structure Material Substitution and Repair in the amount of $1.1 million are in the process of being moved to PE 0602102F, Materials, from PE 0702207F, Depot Maintenance, for execution.

(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 2006	FY 2007	FY 2008	FY 2009
(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.	3.642	5.784	6.343	6.376

(U) In FY 2006: Demonstrated electromagnetic technology to detect and characterize multi-site damage and cracks in large area, aging structures. Developed computer simulations and models of NDI/E technique response to enable rapid assessment of multiple NDI/E technologies for depot level inspections. Initiated efforts to explore and develop NDI/E technologies for inspection of thick (multi-layer) aging aircraft structures with complex geometries. Evaluated feasibility of advanced LO NDI/E methods and systems for use in battle damage assessment and for inspection following battle damage repair. Transitioned 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.

(U) In FY 2008: Mature modeling and simulation methodologies for rapid assessment of multiple NDI/E

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	technologies for depot level inspections. Validate NDI/E technologies for inspection of thick (multi-layer) aging aircraft structures with complex geometries. Initiate studies of harsh environment sensors to enable health management for turbine engines and thermal protection systems.				
(U)	In FY 2009: Demonstrate novel NDI/E methods and techniques to detect and track damage in a wide variety of materials and components for aerospace systems. Demonstrate NDI/E technologies for inspection of thick (multi-layer) aging aircraft structures with complex geometries. Develop sensing technology to detect changes in temperature, strain, pressure, and vibration to enable on-demand health status of turbine engines, aircraft structures, wiring systems, and thermal protection systems.				
(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.	4.955	7.081	4.889	4.998
(U)	In FY 2006: Applied 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. Evaluated 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)	In FY 2008: Develop advanced techniques to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Develop advanced materials and processes technology to repair Air Force legacy systems and test failure limits for emerging Air Force systems. Initiate analysis to understand the effects of materials processes, such as the application of residual stress on the surface of steel and other structural metals, to support customer focused studies and point design solutions that will extend the life of specific components on Air Force systems. Demonstrate technologies for improved maintainability of advanced LO materials and designs, such as conductive outer-mold-line, applique, door edges and seals, and multifunctional systems.				
(U)	In FY 2009: Validate advanced techniques to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Evaluate advanced materials and processes technology to repair Air Force legacy systems and test failure limits for emerging Air Force systems. Develop test methods and techniques to understand the effects of materials processes, like the application of residual stress on the surface of steel and other structural metals, to support studies and point design solutions that will extend the life of specific structural components on Air Force systems.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Demonstrate and transition technologies for improved maintainability of advanced LO materials and designs, such as conductive outer-mold-line, applique, door edges and seals, and multifunctional systems.				
(U)					
(U)	MAJOR THRUST: Develop support capabilities, information, and processes to resolve materials problems and provide electronic and structural failure analysis of components.	3.950	4.694	5.785	5.885
(U)	In FY 2006: Performed failure analysis and materials investigations for field, acquisition, and depot organizations. Demonstrated electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Evaluated new test methodologies for analyzing structural failures of emerging materials for Air Force systems. Evaluated 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)	In FY 2008: Perform quick response failure analysis and materials investigations for fielded system, acquisition organization, depot system materials failures, and provide advanced materials solutions to ensure system availability and safety of flight. Develop advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Demonstrate advanced test methodologies for analyzing structural failures of emerging materials for Air Force systems. Develop advanced wiring materials technologies to replace aging wiring systems and new wiring technologies for emerging weapons systems.				
(U)	In FY 2009: Perform quick response failure analysis and materials investigations for fielded system, acquisition organization, depot system materials failures, and provide advanced materials solutions to ensure system availability and safety of flight. Develop advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Demonstrate advanced test methodologies for analyzing structural failures of emerging materials for Air Force systems. Develop advanced 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 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Develop enabling technologies to reduce the Air Force LO maintenance burden. Note: In FY 2008, efforts in this thrust will be combined with other major thrusts in this project.	3.908	0.789	0.000	0.000
(U)	In FY 2006: Developed multispectral/multipurpose tool for inspection of LO systems on aircraft. Investigated 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Accelerated Insertion of Advanced Materials for Materials Substitution and Repair - National Institute for Aviation Research.	0.000	1.295	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Accelerated Insertion of Advanced Materials for Materials Substitution and Repair - National Institute for Aviation Research.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	16.455	19.643	17.017	17.259

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4349 Materials Technology for Sustainment**

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

Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	0602102F Materials	4915 Deployed Air Base Technology

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4915 Deployed Air Base Technology	5.855	5.740	2.580	2.324	2.727	2.755	2.813	2.885	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop new deployable airbase technologies to reduce airlift and manpower requirements, setup times, and sustainment costs in support of AEF operations.	1.252	1.377	1.234	0.952
(U) In FY 2006: Investigated fabrication techniques to integrate solid state solar cell technology into deployable shelter fabrics. Developed advanced heat and mass transfer technologies and thin film catalysis for logistic fuel processing planar technology. Developed an advanced work-recovery rotary expansion device to improve deployed air conditioning performance. Demonstrated polymer-clay stabilization agents for rapid airfield expansion. Refined ground penetrating radar interpretation capability to improve man-portable rapid airfield assessment. Developed 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) In FY 2008: Develop and analyze solar power for bare base applications. Transition Fuel Cell Reformer specification for acquisition. Begin development of advanced integrated power technologies. Investigate and evaluate high temperature effects on operating surfaces and develop repair technology. Demonstrate nondestructive inspection of airfield surface evaluation technologies. Demonstrate cost effectiveness and performance of synthesized polymer materials.				
(U) In FY 2009: Demonstrate advanced integrated power technologies. Evaluate and develop mitigation for high temperature effects on operating surfaces. Demonstrate and analyze nondestructive inspection of airfield surface evaluation technologies.				
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop affordable technologies to provide force protection and survivability to AEF deployed warfighters and infrastructure. Note: This effort includes Congressional Add funding of $3.5 million in FY 2006 ($1.4 million for Blast Resistant Barriers for Homeland Defense and $2.1 million for Thermal Sprays for Structural Blast Mitigation) and $3.1 million in FY 2007 ($2.0 million for Blast Resistant Panels for Buildings, Shelters, and Vehicles and $1.1 million for Fire and Blast Resistant Materials for Force Protection).	4.603	4.363	1.346	1.372
(U)	In FY 2006: Developed fire fighting agents with increased versatility by combining agents and application methodologies. Developed technologies for increased fire fighter situational awareness, improved synergy, and greater on-site duration. Researched resilient infrastructure technologies for more effective protection of structures and inhabitants. Developed technologies to protect against the ballistic and fragmentation effects of improvised explosive device threats and characterize high energy weapons threats. Modeled 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)	In FY 2008: Develop methodologies to characterize candidate fire suppression agents and begin development of supporting fire suppression technologies for crash/rescue. Develop and evaluate combined technologies for fire fighter effectiveness. Demonstrate and analyze effectiveness of resilient structural materials and methodologies for improved protection of structures and inhabitants. Investigate and analyze effectiveness of innovative improvised explosive defeat and high energy threat. Investigate mechanisms of gas phase kinetics. Develop and evaluate accuracy for atmospheric models for protection of deployed warfighters from asymmetric threats.				
(U)	In FY 2009: Develop and demonstrate methodologies to characterize candidate fire suppression agents and continue to develop supporting fire suppression technologies for crash/rescue. Develop and analyze combined technologies for fire fighter effectiveness. Validate and demonstrate resilient structural materials and methodologies for improved protection of structures and inhabitants. Develop and demonstrate effectiveness of innovative defeat of IED and high energy threats. Expand evaluation				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4915 Deployed Air Base Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	development and demonstration for wider variety of compounds for atmospheric models for protection of deployed warfighters from asymmetric threats.				
(U)	Total Cost	5.855	5.740	2.580	2.324

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2007

BUDGET ACTIVITY
02 Applied Research

PE NUMBER AND TITLE
0602201F Aerospace Vehicle Technologies

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	102.792	118.901	131.948	119.637	144.898	146.714	142.567	146.421	Continuing	TBD
22SP	Applied Space Access Vehicle Tech	0.000	3.797	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
2401	Structures	37.077	46.136	38.132	37.681	51.802	50.629	44.892	61.039	Continuing	TBD
2403	Flight Controls and Pilot-Vehicle Interface	26.753	37.269	37.501	33.765	37.196	39.375	38.475	37.574	Continuing	TBD
2404	Aeromechanics and Integration	38.962	31.699	56.315	48.191	55.900	56.710	59.200	47.808	Continuing	TBD

Note: 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 2007, Congress added $2.4 million for Neurobiologically Autonomous Vehicle Operations, $1.0 million for the Unmanned Air Vehicle Research, $1.0 million for Sentient Adaptive Systems for Rapid Vehicle Condition-Based Maintenance, and $2.2 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.

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

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	104.469	112.751	106.517	111.837
(U)	Current PBR/President's Budget	102.792	118.901	131.948	119.637
(U)	Total Adjustments	-1.677			
(U)	Congressional Program Reductions				
	Congressional Rescissions	-0.003	-0.450		
	Congressional Increases		13.100		
	Reprogrammings	-0.298	-6.500		
	SBIR/STTR Transfer	-1.376			

(U) Significant Program Changes:

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602201F Aerospace Vehicle Technologies**

Not Applicable.

(U) C. Performance Metrics

Under Development

Exhibit R-2a, RDT&E Project Justification

DATE: February 2007

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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
22SP	Applied Space Access Vehicle Tech	0.000	3.797	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	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. In FY 2008, efforts were terminated due to higher Air Force priorities.

(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 2006	FY 2007	FY 2008	FY 2009
(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	3.797	0.000	0.000
(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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	Total Cost	0.000	3.797	0.000	0.000

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602201F Aerospace Vehicle Technologies**	PROJECT NUMBER AND TITLE **2401 Structures**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2401 Structures	37.077	46.136	38.132	37.681	51.802	50.629	44.892	61.039	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop an economic service life analysis capability comprised of analysis tools, methodologies, and structural health monitoring schemes.	2.060	2.120	3.705	3.593

(U) In FY 2006: Continued 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. Incorporated newly developed analysis tools into life prediction and failure analysis. Continued 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) In FY 2008: Based upon results of demonstration efforts in PE 0603211F - Aerospace Technology Dev/Demo, refine 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. Continue the development analysis tools into life prediction and failure analysis. Continue to develop failure criteria tools for advanced high temperature aircraft components and concepts.

(U) In FY 2009: 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.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Continue the development 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 cost and time involved in actual full-scale testing of components and aircraft prior to obtaining airworthiness certification.	6.886	7.293	3.716	3.314
(U)	In FY 2006: Continued 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)	In FY 2008: Continue development of analytical certification methodologies that incorporate advanced methods, concepts, diagnostic techniques, and manufacturing technologies into legacy aircraft components and airframe design. Incorporate newly developed analysis in 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 2009: Continue development of analytical certification methodologies that incorporate advanced methods, concepts, diagnostic techniques, and manufacturing technologies into legacy aircraft components and airframe design. Initiate development of high-fidelity and continue 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.	12.726	19.442	17.582	17.296

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602201F Aerospace Vehicle Technologies**	PROJECT NUMBER AND TITLE **2401 Structures**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2006: Continued development and initiated 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. Initiated the development and analysis of critical subsystem hardware integration methods to enable directed energy weapons to be carried out on future air vehicles. Completed analysis and continued feasibility determination of energy storage concepts that are integrated into load-bearing structures. Continued the development and initiated evaluation, assessment, and ground evaluation of adaptive structures and antenna integration concepts into load-bearing structures to create multi-function or ultra-lightweight concepts.				
(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)	In FY 2008: 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. Continue development, analysis, evaluation and simulation of innovative technologies to advance active aero elastic design concepts, adaptive structures, aerodynamic flow control technologies, system health reasoners and active denial concepts. Initiate characterization of high energy laser concepts. Initiate development, evaluation, and assessment of multi-functional structures to include ground demonstration of energy storage concepts, integrated distributed electronics, and homogeneous sensor integration systems.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2009: 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. Initiate analysis for capabilities for conformal load bearing antenna structure. 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. Continue development, analysis, evaluation and simulation of innovative technologies to advance active aero elastic design concepts, adaptive structures, aerodynamic flow control technologies, system health reasoners and active denial concepts. Continue characterization of high energy laser concepts. Continue development, evaluation, and assessment of multi-functional structural to include ground demonstration of energy storage concepts, integrated distributed electronics, and homogeneous sensor integration systems.				
(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.	15.405	17.281	13.129	13.478
(U)	In FY 2006: Refined 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. Continued 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)	In FY 2008: 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. Incorporate newly developed structural concepts and analysis methods for design and evaluation of hot primary structure.				

Exhibit R-2a, RDT&E Project Justification

DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602201F Aerospace Vehicle Technologies**	**2401 Structures**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: 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. Incorporate newly developed structural concepts and analysis methods for design and evaluation of hot primary structure.				
(U)					
(U)	Total Cost	37.077	46.136	38.132	37.681

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602201F Aerospace Vehicle Technologies**	**2403 Flight Controls and Pilot-Vehicle Interface**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2403	Flight Controls and Pilot-Vehicle Interface	26.753	37.269	37.501	33.765	37.196	39.375	38.475	37.574	Continuing	TBD
	Quantity of RDT&E Articles	0	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.

(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 2006	FY 2007	FY 2008	FY 2009
(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.	9.507	16.145	20.752	18.380

(U) In FY 2006: Furthered 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. Developed high-density optical component technologies for adverse environments that reduce subsystem size, weight, and cost, while considering maintainability. Designed systems for safety-critical control using high-density optical components. Continued to develop and assess tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Developed technologies and analysis tools to extend design-time verification and validation of intelligent, autonomous, and reconfigurable control systems for enhanced assurance. Continued the 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 integrated health management. Continued 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

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	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)	In FY 2008: 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. Complete development of high-density optical component technologies for adverse environments that reduce subsystem size, weight, and cost while considering maintainability. Complete systems design for safety-critical electromagnetic tolerant systems. Complete the assessment of enhanced tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Complete refinement of actuation fault compensation technologies for integrated vehicle health management.				
(U)	In FY 2009: 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. Initiate development of control architecture enhancements to enable design for certification to ease validation and verification for complex and adaptive unmanned systems. Initiate development of low-maintenance/fault tolerant control-effector technology for aerospace applications.				
(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.	4.506	9.783	9.817	8.665
(U)	In FY 2006: Assessed novel control automation techniques and adaptive algorithms to enable safe and interoperable application of manned and unmanned aerospace systems. Continued to enhance reliability				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	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 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)	In FY 2008: 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 performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Continue development and assessment of cooperative control techniques for close-in surveillance of urban environments. Complete control and situational awareness requirements development for interoperability of unmanned vehicles in terminal area and ground operations. Develop and assess adaptive guidance and control technologies for fault/damage tolerant aerospace vehicle operations.				
(U)	In FY 2009: Continue to develop and assess novel control automation techniques and adaptive algorithms to enable safe and interoperable application of manned and unmanned aerospace systems. Complete reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Complete development and assessment of cooperative control techniques for close-in surveillance of urban environments. Initiate technology development for interoperability of unmanned vehicles in terminal area and ground operations. Continue to develop and assess adaptive guidance and control technologies for fault/damage tolerant aerospace vehicle operations.				
(U)					
(U)	MAJOR THRUST: Develop tools and methods for capitalizing on simulation-based research and development of future aircraft.	5.997	6.958	6.932	6.720
(U)	In FY 2006: Conducted assessments of advanced manned and unmanned aerospace concepts in simulated future environments. Conducted analysis of future strike concepts in a 2020+ virtual environment. Continued analysis of long endurance intelligence, surveillance, and reconnaissance platforms in a network centric environment. Continued to support simulation activities for advanced				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602201F Aerospace Vehicle Technologies**	PROJECT NUMBER AND TITLE **2403 Flight Controls and Pilot-Vehicle Interface**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	transports and future tankers. Supported 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)	In FY 2008: Refine network-centric environment to broaden advanced technology assessment capability. Expand breadth of simulation analyses in refined net-centric environment to address multi-directorate technology trade studies for refined long-range strike and reconnaissance concepts. Continue technology trade studies for next generation theater transports. Conduct simulations to analyze advanced launch and reentry technologies for access-to-space concepts. Continue technology trade studies of small and medium sized unmanned air vehicles in hostile urban environments.				
(U)	In FY 2009: Refine network-centric environment to broaden advanced technology assessment capability. Expand breadth of simulation analyses in refined net-centric environment to address multi-directorate technology trade studies for refined long-range strike and reconnaissance concepts. Continue technology trade studies for next generation theater transports. Conduct simulations to analyze advanced launch and reentry technologies for access-to-space concepts. Continue technology trade studies of small and medium sized unmanned air vehicles in hostile urban environments.				
(U)					
(U)	CONGRESSIONAL ADD: Intelligent Flight Control Simulation Research.	0.973	0.000	0.000	0.000
(U)	In FY 2006: Continued Congressionally-directed effort for intelligent flight control simulation research laboratory.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Sentient Adaptive Systems Technology for Vehicle Condition-Based Maintenance.	1.653	0.996	0.000	0.000
(U)	In FY 2006: Initiated Congressionally-directed effort for sentient adaptive systems technology for vehicle condition-based maintenance.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602201F Aerospace Vehicle Technologies**	PROJECT NUMBER AND TITLE **2403 Flight Controls and Pilot-Vehicle Interface**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2007: Continue Congressionally-directed effort for sentient adaptive systems technology for vehicle condition-based maintenance.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Modeling and Simulation for Rapid Integration and Technology Evaluation.	1.653	0.000	0.000	0.000
(U)	In FY 2006: Initiated Congressionally-directed effort for rapid integration and technology evaluation.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Unmanned Systems Initiative for Army Missile Research, Development, Engineering Center (AMRDEC).	2.464	0.000	0.000	0.000
(U)	In FY 2006: Initiated Congressionally-directed effort for unmanned systems initiative for AMRDEC.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Neurobiologically Autonomus Vehicle Operations	0.000	2.391	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Initiate Congressionally-directed effort for neurobiologically autonomus vehicle operations.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Unmanned Air Vehicle Research	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Initiate Congressionally-directed effort for unmanned air vehicle research.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602201F Aerospace Vehicle Technologies**	PROJECT NUMBER AND TITLE **2403 Flight Controls and Pilot-Vehicle Interface**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)					
(U)	Total Cost	26.753	37.269	37.501	33.765

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602201F Aerospace Vehicle Technologies**	**2404 Aeromechanics and Integration**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2404 Aeromechanics and Integration	38.962	31.699	56.315	48.191	55.900	56.710	59.200	47.808	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop aerodynamic prediction efforts centered on expanding the design capabilities of manned and unmanned air vehicles.	4.839	3.402	4.061	3.226

(U) In FY 2006: 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. Evaluated the application of flow control techniques to complex air vehicle designs to achieve reduced drag and improved propulsion system performance. Continued 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 vehicles.

(U) In FY 2008: 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. Continue 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. Initiate development of fluid-based

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	thrust vectoring concept for unmanned air vehicle. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles.				
(U)	In FY 2009: 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 of innovative aerodynamic control methods for small unmanned air vehicles. Refine development of fluid-based thrust vectoring concept for unmanned air vehicle. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air 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 2006 and out, increased emphasis has been placed on assessing the next generation long-range, high-speed air vehicle concepts. Note: Provide support to SECAF directed effort (Energy Conservation - Assured Fuels Initiative) to identify and develop technologies that provide revolutionary aircraft configurations that enable the use of domestic fuel sources for military energy needs.	18.143	16.373	26.931	19.758
(U)	In FY 2006: Continued development and assessment of aerospace technologies that enable sustained high-speed flight to permit global reach. Continued development of integrated airframe propulsion design concepts for high-speed aerospace vehicles. Conducted computational aerodynamic analysis and sub-scale aerodynamic testing of advanced inlet boundary layer flow control techniques, secondary flow devices, and high-speed inlet apertures. Conducted computational aerodynamic analysis of high performance vectoring exhaust nozzles. Continued development of analytic methods for modeling the plasma flow field over high-speed vehicles to significantly reduce drag. Conducted 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.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	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)	In FY 2008: 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. Initiate study of energy-based analysis and optimization techniques for vehicle design. Evaluate supersonic tailless aerodynamic concepts. Initiate efforts to characterize hypersonic phenomena and develop and validate fundamental hypersonic component technologies through experimental flight techniques in a relevant high-speed environment. Initiate efforts to integrate self-defense systems to counter multi-spectrum system threats. Evaluate sub-scale aerodynamic integrated inlet concepts on high efficiency aero configurations for system level performance. Evaluate thermally integrated structures for lightweight integrated exhaust systems and airframes. Continue high fidelity aerodynamic testing of advance control techniques for low-speed and high-speed operation. Validate analytical stability and control simulations for system level operability. Note: Provide support to SECAF directed effort (Energy Conservation - Assured Fuels Initiative) to identify and develop technologies that provide revolutionary aircraft configurations that enable the use of domestic fuel sources for military energy needs.				
(U)	In FY 2009: 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. Continue efforts to integrate self-defense systems to counter multi-spectrum system threats. Initiate advanced high-speed aero/flight control development. Initiate study of interaction of high-load, high-temperature flexible structural materials and fluid mechanics of inlet. Initiate component development enabling shock/boundary layer interaction control. Initiate study of exhaust systems for advanced hypersonic vehicles, and initiate cold-flow testing of sub scale components. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through experimental flight techniques in a relevant environment. Note: Provide support to SECAF directed effort (Energy Conservation - Assured Fuels Initiative) to identify and develop technologies that provide revolutionary aircraft configurations that enable the use of domestic fuel sources for military energy needs.				
(U)					

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602201F Aerospace Vehicle Technologies**	PROJECT NUMBER AND TITLE **2404 Aeromechanics and Integration**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	MAJOR THRUST: Develop new and improved concepts, designs, and analysis of technologies to enable revolutionary capabilities for re-useable, high altitude aircraft. Note: The FY 2006 and FY 2007 efforts will be leveraging the results of the high-speed Major Thrust area previously listed above.	5.119	1.842	6.717	7.324
(U)	In FY 2006: Continued development and assessment of aerospace technologies that enable high-speed flight to permit reuseable, high altitude aircraft. Continued 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. Continued and evaluated 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)	In FY 2008: Continue development and assessment of aerospace technologies that enable reusable, space-access aircraft. Develop robust design methodology and integration approaches for high-speed aeropropulsion. Develop extensive application and 3D validation experience in applying aerothermal computational tools to conceptual, ground-tested and flight-tested vehicles traveling at high-speeds. Develop unique high temperature structures and materials in support of re-usable space-access aircraft. Pursue multi-disciplinary optimization of complex high speed, high temperature, reusable air vehicles.				
(U)	In FY 2009: Continue development and assessment of aerospace technologies that enable reusable, space-access aircraft. Enhance robust design methodology and integration approaches for high-speed aeropropulsion. Continue extensive application and 3D validation experience in applying aerothermal computational tools to conceptual, ground-tested and flight-tested vehicles traveling at high-speeds. Refine unique high temperature structures and materials in support of high speed re-usable space-access aircraft. Continue multi-disciplinary optimization of complex high-speed, high temperature, reusable air vehicles. Initiate design and test of components of integrated high-speed space-access air vehicle system.				
(U)					
(U)	MAJOR THRUST: Develop enabling technologies to allow integration of directed energy weapons into	3.556	1.789	2.278	1.108

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	current and future air vehicle platforms.				
(U)	In FY 2006: Continued 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. Completed analysis of tactical utility of 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 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. Complete measurements of the actual aero-optics effects encountered when employing a laser weapon on a fighter aircraft.				
(U)	In FY 2008: Initiate development of combined flow control and adaptive optics systems to optimize directed energy system performance on large low speed aircraft. Initiate development of analysis tools for predicting the performance of advanced flow control and adaptive optics systems.				
(U)	In FY 2009: Continue development of combined flow control and adaptive optics systems to optimize directed energy system performance on large low-speed aircraft. Continue development of analysis tools for predicting the performance of advanced flow control and adaptive optics systems. Initiate preliminary design of beam control systems for large scale demonstration.				
(U)					
(U)	MAJOR THRUST: Develop and assess technologies for the next generation of multi-role large aircraft. Note: In FY 2008 and out, investment is increasing due to higher Air Force priority for next generation large aircraft.	4.971	6.101	16.328	16.775
(U)	In FY 2006: Continued 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. Continued 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)	In FY 2008: Continue development and assessment of aeronautical technologies including high-lift systems, transonic, and structural concepts that enable revolutionary tanker and transport aircraft designs				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	for rapid global mobility. Continue to develop technologies that enable multiple roles and missions for delivery and support aircraft. Initiate trade studies between short take-off and landing performance, and high-speed cruise. Initiate development of inlet and integration technologies for an advanced mobility platform designed to operate efficiently at transonic speeds and provide short take-off capabilities.				
(U)	In FY 2009: Continued development and assessment of aeronautical technologies including high-lift systems, transonic, and structural concepts 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. Optimize configuration for trade-off between short take-off and landing performance, and high speed cruise. Continue development of inlet and integration technologies for an advanced mobility platform designed to operate efficiently at transonic speeds and provide short take-off capabilities.				
(U)					
(U)	CONGRESSIONAL ADD: Unique Stealth Unmanned Air Vehicle Houck Aircraft Design Program.	1.361	0.000	0.000	0.000
(U)	In FY 2006: Continued Congressionally-directed effort for unique stealth unmanned air vehicle Houck aircraft design program.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Wright Brothers Institute (WBI) - Characterization of Airborne Environment for Tactical Lasers.	0.973	2.192	0.000	0.000
(U)	In FY 2006: Initiated Congressionally-directed effort for WBI - characterization of airborne environment for tactical lasers.				
(U)	In FY 2007: Continue Congressionally-directed effort for WBI - characterization of airborne environment for tactical lasers.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	Total Cost	38.962	31.699	56.315	48.191

Exhibit R-2a, RDT&E Project Justification		DATE **February 2007**
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 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 2007

BUDGET ACTIVITY
02 Applied Research

PE NUMBER AND TITLE
0602202F Human Effectiveness Applied Research

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	111.369	109.174	79.856	79.377	94.344	85.960	88.339	92.936	Continuing	TBD
1123	Warfighter Training	16.992	20.247	13.024	13.850	14.160	14.620	14.929	15.271	Continuing	TBD
7184	Decision Effectiveness & Biosciences	68.731	62.682	48.597	47.368	60.812	53.080	55.151	58.978	Continuing	TBD
7757	Bioeffects and Protection	25.646	26.245	18.235	18.159	19.372	18.260	18.259	18.687	Continuing	TBD

(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 in extreme environments, 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 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 multiple military unique stressors in extreme environments or during sustained operations, directed energy, and other threats on personnel and mission performance. Note: In FY 2007, Congress added $2.0 million for AIRPRINT, $1.6 million for C4ISR Fusion System, $1.0 million for Bio Medical DNA Program, $1.3 million for Battlefield Automatic Life Status Monitor, $1.0 million for Miniature Tri-Axial Accelerometer, $1.0 million for Eyewear Display for Battlefield Operations, $1.0 million for Unmasking Deception and Denial, $1.0 million for Networked Warfighter Decision Support, $1.1 million for COM Attitude Control System Simulation/Trainer, $4.3 million for Solid Electrolyte Oxygen Separator, and $1.0 million for Warfighter Sustainability: Maximizing Human Performance. 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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	108.171	92.991	80.574	84.135
(U)	Current PBR/President's Budget	111.369	109.174	79.856	79.377
(U)	Total Adjustments	3.198			
(U)	Congressional Program Reductions		-0.005		
	Congressional Rescissions	-0.074	-0.413		
	Congressional Increases		14.500		
	Reprogrammings	4.734	2.101		
	SBIR/STTR Transfer	-1.462			

(U) Significant Program Changes:

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**

Not Applicable.

C. Performance Metrics
Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE
February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602202F Human Effectiveness Applied Research**	**1123 Warfighter Training**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
1123 Warfighter Training	16.992	20.247	13.024	13.850	14.160	14.620	14.929	15.271	Continuing	TBD
Quantity of RDT&E Articles	0	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 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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Research perceptual issues involving the development of new visual and sensor simulation technologies to enhance Distributed Mission Operations (DMO) and decision dominance 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.	1.381	2.693	1.603	2.051
(U) In FY 2006: Researched and analyzed human factor and perceptual issues for off-boresight targeting simulation in DMO multifaceted simulator displays. Evaluated and researched techniques for cockpit, helmet-mounted, and out-the-window visual simulation systems for air-to-ground and composite force training. Identified, researched, and resolved head-mounted and deployable display issues for next generation deployable visual simulation systems. Conducted engineering and human factors analyses of display devices.				
(U) In FY 2007: Research and analyze key perceptual performance parameters for new deployable visual display technologies including resolution, image stability, target tracking database characteristics, accuracy, and transport delay. Perform human training research of head-mounted and deployable displays. Research and evaluate visual system requirements for air-to-ground and composite force training.				
(U) In FY 2008: Research perceptual issues for out-the-window display and targeting pod simulation systems that will allow for greater realistic composite force training. Explore perceptual characteristics for new deployable visual display technologies. Expand human factors visual research to define display requirements for a fully immersive collaborative environment for DMO.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 1123 Warfighter Training

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Complete human factors research, tests, and evaluations of visual system components for air-to-ground and air-to-air composite force training. Conduct perceptual evaluations of deployable display concepts and components. Identify and analyze engineering and perceptual performance visual display concepts for a fully multi-modal immersive environment for DMO. Examine all AF mission areas for training simulation and visual systems applications, and identify key visual science and technology issues.				
(U)					
(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. Enhances the quality, management, and effectiveness of all aspects of DMO, live operations training, rehearsal and exercise environments through the identification and application of competency-based training methods. Research technologies that will enable DMO and mission rehearsals to run new, complex models/simulations at real- or near real-time. This research will provide vastly improved synthetic forces and aircraft simulator capabilities that feature high fidelity electronic warfare, aerodynamic, and weapons effect models that accurately represent the actual capabilities of both current and future systems and threats.	8.345	9.441	8.037	8.180
(U)	In FY 2006: Evaluated integrated learning and readiness assessment models, data, and specifications. Assessed usability of exemplar DMO training scenario design tool. Explored and evaluated virtual environment training syllabi capable of tailoring to individual needs. Investigated fully immersive training environments, with realistic, interactive visual scenery that can be adapted by multiple platforms. Analyzed 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. Analyze fully immersive, just-in-time training environments, with realistic, interactive content and training strategies that can be adapted for use within and across missions. Create a learning management-based migration plan for integrating full fidelity training and rehearsal systems with more generalizable software-driven training, rehearsal, and exercise environments.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **1123 Warfighter Training**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Evaluate approaches and tools for integrating principles of learning in live, virtual, and constructive environments. Identify methods and tools to manage learning in operational training contexts. Identify and analyze methods of routinely assessing knowledge and skills for combat readiness. Analyze field data to identify opportunities for competency-based training integration. Analyze how to monitor the integration of distributed training and rehearsal into operational readiness contexts. Evaluate common measurement tools for assessing readiness in air-to-air, air-to-ground, and close air support training, rehearsal, and exercise events. Explore scenario sequencing methods for continuous learning. Conduct in-depth analysis of the training related shortfalls of current DMO computer generated forces. Explore hardware and software solutions allowing functional processing of selected friendly/enemy interactions for extremely high fidelity training. Research and analyze parameters for a network server for high-fidelity weapons models which allows real- or near real-time processing of DMO interactions for more accurate weapons effects and engagements.				
(U)	In FY 2009: Develop tools to permit AF planners and managers to integrate competency-based methods into readiness parameters and assessment in operational training, rehearsal, and exercise. Identify alternative approaches for evaluating the individual, team, and team of team (coalition) performance impacts of collaborative, distributed spin-up training and rehearsal. Evaluate integrated instructional development and management methods for continuous learning in DMO and explore task allocation methods for performance aiding and training in operational contexts. Identify functional requirements for instructor operator station capabilities. Investigate and evaluate physics-based directed energy threat models for DMO systems. Define improved rule sets to enhance training utility of computer generated forces. Assess feasibility of enhanced threat avoidance and rehearsal training combining selected aerodynamic models, directed energy models, and validated visual special effects.				
(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 AF career fields, from combat air forces to command and control personnel.	1.720	3.431	3.384	3.619
(U)	In FY 2006: Created a communication model through cognitive science principles and techniques to improve the training of AOC airmen. Established 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.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **1123 Warfighter Training**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2007: Integrate the communication model with a synthetic communication agent/teammate and assess training value. Verify and validate the knowledge and skill tracking prediction models with actual training data. Implement initial semi-automated parameter search capability with high performance computing for moderator models.				
(U)	In FY 2008: Expand the depth of the communication models to support the full range of vocabulary and grammar used in the AOC training environment. Conduct empirical study with skill acquisition/retention models. Extend automation functionality to include dynamic model validity and refinement capability.				
(U)	In FY 2009: Expand the breadth of the communication model to support end-to-end language processing. Integrate knowledge and skill tracking prediction system with mission essential competencies to predict training requirements for airmen and demonstrate ability to produce individualized training programs. Implement graphical user interface for performance moderator prediction system.				
(U)					
(U)	CONGRESSIONAL ADD: Airman Performance Integration (AIRPRINT) (previously titled Improved Performance Research Integration Tool (IMPRINT)).	2.432	1.993	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for IMPRINT.				
(U)	In FY 2007: Conduct Congressionally-directed effort for AIRPRINT.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Component Object Model (COM) Attitude Control System Simulation/Trainer.	2.141	1.096	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for COM Attitude Control System Simulation/Trainer.				
(U)	In FY 2007: Conduct Congressionally-directed effort for COM Attitude Control System Simulation/Trainer.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: C4ISR Fusion System.	0.973	1.593	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **1123 Warfighter Training**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2006: Conducted Congressionally-directed effort for C4ISR Fusion System.				
(U)	In FY 2007: Conduct Congressionally-directed effort for C4ISR Fusion System.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	Total Cost	16.992	20.247	13.024	13.850

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0602233N, Human Systems 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
7184	Decision Effectiveness & Biosciences	68.731	62.682	48.597	47.368	60.812	53.080	55.151	58.978	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops the technology required to identify human impact from deployment, and enhance deployment capabilities, human performance, biodynamic response, and survivability in dispersed 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; it determines human responses to military unique stresses such as operations in sustained and extreme environments including the effects of noise, impact, vibration, and maneuvering acceleration, and it explores ways to assess and manage human operator workload by 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, team communications, and modeling and simulation for human-centered aerospace and cyber operations. It conducts experiments and evaluations of control interfaces, crew station layout and functional integration, and human information processing. It also develops biotechnologies and tools to identify and minimize the risks and mission impact to DoD personnel from exposure to military unique stressors while also reducing human weapon systems life cycle cost.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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.	4.862	5.680	4.990	4.956

(U) In FY 2006: Initiated development of a laboratory prototype of a speech recognizer/synthesizer based on multilingual phoneme acoustic models designed to enhance collaboration between multinational forces. Completed development of human-machine interface style guide and commenced development of a collaboration toolkit, both essential for developing effective warfighter interfaces for air battle management command and control (BMC2). Completed 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 advance speech processing technology. Complete development of a collaboration toolkit for BMC2. Develop and evaluate BMC2 decision support technologies, and formulate plans 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.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2008: Begin to develop multinational speech translator technologies for obscure languages and continue to advance technologies that support mobile, speech-based interfaces. Complete a style guide for applying collaborative tools in BMC2 environments. Begin to develop a collaboration toolkit for non-airborne command and control missions. Expand the operator cognitive state assessor to incorporate operator performance data, operator performance and situational awareness models, and tactical situation information for better decision support.				
(U)	In FY 2009: Explore the use of transparent multilingual collaboration tools for distributed multi-entity teaming. Continue to develop multinational speech translation technologies for obscure languages. Determine the effects of collaboration technologies on performance efficiency, shared situation awareness, workload and decision making for tactical command and control. Begin to develop adaptive automated human-machine interfaces to improve real-time human-machine task sharing. Develop predictive operator state models and assessment tools for dynamic workflow and workload management.				
(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.	3.439	4.655	3.977	4.350
(U)	In FY 2006: Identified and developed software design patterns that enable the standardization and re-use of human-computer interface elements in command and control ISR systems. Began to develop collaboration techniques that enable diverse users to share a common object representation of the problem domain. Researched the cultural and ethnic bases of human decision-making. Developed 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 ISR systems. Continue to develop collaboration techniques and methods to embed them into 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)	In FY 2008: Continue advancement of software design patterns that enable the standardization and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **7184 Decision Effectiveness & Biosciences**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	re-use of human-computer interface elements in command and control ISR systems. Begin to develop a DoD software design patterns library. Continue development of collaboration techniques and methods to embed these techniques into command and control systems. Demonstrate collaboration techniques in a distributed net-centric environment. Continue researching the cultural and ethnic bases of human decision making and proceed with developing human performance models that reflect cultural differences for effects-based operations.				
(U)	In FY 2009: Expand contents of DoD software design patterns library. Begin embedding design patterns in graphical user interface building tools. Continue to demonstrate collaboration techniques in a distributed net-centric environment. Investigate how collaboration techniques can enable distributed team self-synchronization. Continue researching the cultural and ethnic bases of human decision making and developing human performance models that reflect cultural differences to enable effects-based operations. Transition select models to advanced development programs.				
(U)					
(U)	MAJOR THRUST: Establish the technology base for a decision support environment that enables the Joint Forces Commander, Joint Forces Air Component Commander, and command staffs to interrelate the past, present, and future battlefield mission states and to predict the intent and actions of adversaries during joint operations.	4.164	3.735	1.934	2.284
(U)	In FY 2006: Developed advanced visualization techniques that enable the uncertainty associated with information to be incorporated into the iconic or graphic portrayal scheme for command center display. Developed methods to simulate enemy potential courses of action. Initiated development of "sense making" tools for dynamic battlefields. Researched knowledge representation techniques to model potential adversaries and complex systems of systems. Initiated development of a set of integrated 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, methods needed 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **7184 Decision Effectiveness & Biosciences**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	operational planning, persistent prediction, and focused execution even as military and broad national security objectives are dynamically changing.				
(U)	In FY 2008: Begin the transition of advanced uncertainty visualization techniques for command center displays. Transition towards advanced development, the needed methods to simulate enemy potential courses of action, including more complex adversary behavior. Evaluate results of the laboratory experiments on “sensemaking” tools and displays for dynamic battlefields. Identify gaps for further research. Begin incorporating the extrapolated, select “sensemaking” results into display development. Refine the knowledge representation techniques to model potential adversaries and complex systems of systems and begin integrating into displays. Initiate transition of integrated set of APO work aids to achieve persistent operational planning, persistent prediction, and focused execution. Conduct initial demonstration of the integration of the developed displays and technologies.				
(U)	In FY 2009: Analyze the results of the initial demonstration of the integration of the displays and technologies. Complete the transition of advanced uncertainty visualization techniques for command center display. Continue transition of methods needed to simulate enemy potential courses of action, including more complex adversary behavior. Incorporate more extrapolated “sensemaking” results into displays. Refine the knowledge representation techniques to model potential adversaries and complex systems of systems and begin integrating into displays. Continue transitioning the integrated set of APO work aids to achieve persistent operational planning, persistent prediction, and focused execution and evaluate the effect. Conduct follow-on demonstration of the integration of the developed displays and technologies.				
(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.	4.503	4.845	4.705	4.477
(U)	In FY 2006: Using virtual simulation, evaluated decision support interface concepts to enable single operator supervision of multiple semi-autonomous unmanned systems. For unmanned combat air vehicles, evaluated first generation control-display concepts that reduce operator task load and mitigate channelized attention. Developed fusion algorithms that combine on-board and off-board sensor data with imagery. Explored the integration of computer-generated pictures with sensor images to enable				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	autonomous approach and landing.				
(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 (UAVs) 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)	In FY 2008: Evaluate single operator supervision of multiple autonomous UAVs in a net-centric context using real-time assessment tools and advanced decision support interfaces during testing and simulated ground operations. Transition field test results of first generation control-display concepts that reduce operator task loading and channelized attention into second generation control-display workstations. Apply basic algorithms that blend display imagery with computer-generated graphical representations of terrain and real-time data during simulation and/or fight-testing of autonomous landing and ground operations.				
(U)	In FY 2009: Integrate real-time assessment tools into second generation control-display operator workstations to optimize operator task loading and avoid channelized attention. Use second generation operator workstations during field testing and flight demonstration to control multiple, highly autonomous UAVs. Begin software design and development of common interface and software architectures of control-display concepts that allow minimal numbers of operators to control autonomous UAVs in urban environments and/or in large-scale, strategic military operations.				
(U)					
(U)	MAJOR THRUST: Develop technologies associated with collecting and optimizing visually displayed information for best assimilation by warfighters. Develop, evaluate, and organize algorithms for enhancing input to the visual system through the fusion of multi-spectral sensors, digital image processing, and solid-state display technologies in order to enhance real-time, day/night imaging systems. Devise human-centered command and control symbology and techniques for integration with visual displays, permitting natural situation understanding of complex information rich environments.	5.117	4.385	4.723	4.570
(U)	In FY 2006: Developed algorithms to electronically enhance vision when using head-mounted solid state imagers. Evaluated those algorithms using realistic simulations of warfighter visual tasks. Developed methods to depict command and control and other complex types of information in intuitive,				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	easy-to-understand ways.				
(U)	In FY 2007: Evaluate and improve algorithms to electronically enhance vision when using head-mounted solid state imagers. Improve 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)	In FY 2008: Down-select and implement image-enhancing algorithms that are optimized for speed, visual performance, and real-time tactical use. Develop a laboratory-grade test bed usable to perform field tests. Continue to develop and evaluate new and innovative ways to visualize and interact with large amounts of information in visually rich environments. Evaluate display symbologies and mechanizations in simulated Air and Space Operations Center environments.				
(U)	In FY 2009: Perform multispectral, real-time field evaluations of display algorithm sets that have been optimized for different tactical scenarios. Refine visualization and interaction techniques to enhance decision-making by testing more intuitive symbology and user interfaces. Test these methods against current state-of-the-art to prove and improve total system effectiveness. Begin to develop visualization technologies that enhance situational awareness and battlespace understanding in command centers of the future.				
(U)					
(U)	MAJOR THRUST: Develop advanced audio display technologies for human-to-human collaboration including three-dimensional (3-D) 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 delivery to the warfighter.	3.915	4.361	3.958	3.794
(U)	In FY 2006: Researched acoustic signal control to improve human-to-human communications through noise reduction systems and improved acoustic signal processing. Explored the value of acoustic modeling for operational analysis. Analyzed how to minimize acoustic detection of vectored thrust aircraft. Developed auditory information aiding technologies to improve collaboration in operational command and control environments. Explored 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	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)	In FY 2008: Explore the potential of acoustic aiding during urban operations to improve machine-to-human communications by using acoustic signal processing to improve security forces' information gathering. Begin to research ways to adapt current noise models to enhance decision-making and acoustic detectability during offensive operations. Continue to develop auditory information-aiding technologies for remote collaboration, by exploiting advances in communication theory for individuals. Continue to explore the individual and group processes that lead to communication breakdown. Explore improved auditory sensing to create virtual auditory reality for human interface to remote sensing.				
(U)	In FY 2009: Develop acoustic aiding for urban operations to improve machine-to-human communications by using ultrasonic and laser technology advances to improve security forces' information gathering. Continue to research methods and develop models to predict acoustic detectability under dynamic conditions for improved offensive operations. Continue to develop auditory information-aiding technologies for remote collaboration by exploiting advances in communication theory for individuals. Continue to explore the individual and group processes that lead to communication breakdown. Improve auditory sensing technology to create virtual auditory reality for human interface to remote sensing, emphasizing its application to security forces.				
(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.	8.947	11.375	9.149	10.215
(U)	In FY 2006: Conducted research to develop better visualization for spectral data exploitation and to improve predictive battlespace awareness capabilities. Developed next stage of 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 (MASINT) capabilities, specifically in the spectral area. Develop tools and models for assessing the effectiveness of				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	influence operations. Complete development of proof-of-concept technologies to specify, measure, and model key parameters. Research and develop counter-Improved Explosive Device (IED) concepts/devices.				
(U)	In FY 2008: Validate conceptual human-system interfaces for additional MASINT capabilities. Develop and validate tools and models for assessing the effectiveness of influence operations. Continue research and development of tools and capabilities for Influence Operations and counter-Influence Operations. Continue development of tools and models for assessing the effectiveness of influence operations. Continue research and validation of speech-to-speech translation tool. Develop capability to anticipate adversarial behavior, both individually and in groups. Continue counter-IED research.				
(U)	In FY 2009: Continue development and validation of advanced IO/Influence Operations research tools and training techniques to enable increased offensive and defensive combat capabilities which counter asymmetric adversarial threats. Validate and complete IO/Influence Operations models and simulation capabilities. Develop and validate prototype of advanced speech-to-speech translation tool. Continue development of capability to anticipate adversarial behavior, both individually and in group, with application in the psychological operations domain. Continue counter-IED research. Develop collaborative tools and training for ISR team applications with emphasis on distributed operations.				
(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.	5.455	5.721	4.487	4.125
(U)	In FY 2006: Using available safety and medical databases, evaluated and began addressing primary AF injury and physical health effects causes. Defined criteria functions to relate seat cushion comfort to measurable parameters for use in seating requirements. Developed initial collaborative information system for analyzing environmental threats and developing immunity strategies. Investigated 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	and begin addressing equipment, procedure, or physical training improvements. Develop initial data mining and analysis tools for searching across biomechanics, safety, and medical information systems.				
(U)	In FY 2008: Conduct focused injury surveillance studies on specific career fields and assignments to identify those that have high rates of injury and disability. Based on these studies, begin developing technologies to reduce musculoskeletal disabilities and injuries due to personal equipment and workstation designs. Develop procedures and training improvements to reduce high training attrition due to injury, especially focused on battlefield airmen training. Expand initial biomechanics collaborative information system to coordinate DoD biomechanics data collections and analysis capabilities.				
(U)	In FY 2009: Optimize equipment technologies, refine procedures, and improve training processes to address the most common AF job-related injuries and disabilities. Extend these improvements to not only prevent injuries but also to optimize human performance. Develop workstation design criteria to maximize operator performance and minimize fatigue, based on interrelationships between equipment fit, workload, anthropometry, physical capability, and cognitive capability. Use the biomechanics collaborative information technologies to collect and analyze biometric data for the purpose of friend or foe personnel identification in hostile environments.				
(U)					
(U)	MAJOR THRUST: Quantify and model operator performance in stressful environments and develop technologies to mitigate the effects of operational stressors on cognitive function, safety, and mission effectiveness. Develop solutions to enhance human performance and ensure combat effectiveness in AF operations.	1.562	1.540	2.004	0.538
(U)	In FY 2006: Investigated asymmetric helmet loads in high-G environment and assessed effects on helmet aiming and pointing. Incorporated cognitive model 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 biobehavioral technologies to augment cognition and enhance operator performance.				
(U)	In FY 2008: Continue behavioral research to characterize human performance and mitigate cognitive degradation during demanding military operations. Develop real-time biobehavioral performance monitoring technology to evaluate cognitive readiness and decision making in command and control applications, tactical operations, and mission rehearsal. Explore emerging cognitive disruption				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	technologies and potential countermeasures.				
(U)	In FY 2009: Continue behavioral neuroscience research to characterize and mitigate human cognitive degradation during demanding military operations. Refine real-time biobehavioral performance monitoring technology and develop operational employment concepts. Continue to investigate cognitive disruption technologies and potential countermeasures.				
(U)					
(U)	MAJOR THRUST: Develop, demonstrate, and apply experimental models for predicting toxicological compromises in human mission performance and create in-house and field methods to assure protection of AF personnel from toxic hazards and exposures in Joint operational environments. Using integrated biological approaches, create predictive algorithms to describe functional cellular dynamics and engineering constructs for advancing detection and performance of AF systems. Improve commander decision-making ability to properly balance mission and force protection requirements.	0.816	2.062	1.779	1.560
(U)	In FY 2006: Developed 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. Developed and demonstrated algorithms to describe the function of cellular dynamics with the potential for improved logic and sensor effectiveness for AF 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 AF personnel in operational environments. Further develop and demonstrate algorithms to describe the function of cellular dynamics with the potential for improved logic and sensor capability for Air Force systems.				
(U)	In FY 2008: Develop and apply procedures and computer simulation models to predict effects of large volume material, toxic compound, and nanomaterial exposure on Joint Service and Air Expeditionary Forces. Using computer modeling and integrated biological approaches to understand functional cellular dynamics and engineering, explore and create integrated new sensor and material constructs for AF applications.				
(U)	In FY 2009: Further develop procedures and computer simulation models to predict effects of toxic compound and nanomaterial exposure on Joint Service and Air Expeditionary Forces. Using computer modeling and systems biology approaches to understand functional cellular dynamics and engineering, continue to explore and create integrated new sensor and material constructs for AF applications.				
(U)					

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **7184 Decision Effectiveness & Biosciences**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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 mission success.	4.881	5.844	4.098	3.467
(U)	In FY 2006: Conducted genomic, proteomic, and metabolite studies to identify target-organ biomarkers in body fluids of the deployed airmen exposed to hazardous agents. Assessed kidney and liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on AF 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 AF personnel.				
(U)	In FY 2008: Continue to conduct genomic, proteomic, and metabolite studies to identify target-organ biomarkers and their assessment methods for hazardous agent exposure. Complete validation panel for selected kidney biomarkers and down-select liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on AF personnel.				
(U)	In FY 2009: Complete genomic, proteomic, and metabolite studies to identify and validate kidney and liver biomarkers of hazardous agent exposure in deployed airmen. Extend program to investigate connective tissue, lung, and brain biomarkers of degradation from hazardous agent exposure in AF 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.	1.901	2.203	2.793	3.032
(U)	In FY 2006: Completed examination of new techniques to identify both functional and system requirements. Investigated and applied new information presentation techniques for future logistics and maintenance software tools. Defined "sense-respond" capabilities which will promote effects-based logistics through a common operating picture. Developed 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 for task/job aiding and training. Complete work on defining sense-respond capabilities which will promote effects-based logistics using a net-centric environment.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	Identify technology gaps to meet previously defined emergency response logistics requirements.				
(U)	In FY 2008: Investigate methods for performance measurement and evaluation of augmented reality, virtual reality, and versatile media formats in packaging and delivering job/task aiding and training solutions for maintenance work. Investigate integration mechanisms for these human-centered technologies with on-board diagnostic/health monitoring technologies to promote more accurate system repair processes at the point of maintenance.				
(U)	In FY 2009: Further explore and apply integrated, multifunction job aiding concepts in laboratory and controlled field tests. Investigate the usefulness of collaboration support for troubleshooting and complex field repair problems. Explore the hardware, software, and packaging issues for combined job aid and on-the-job training devices for maintenance work.				
(U)					
(U)	CONGRESSIONAL ADD: Special Operations Target Acquisition and Control Suite (SO-TACS).	1.362	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for SO-TACS.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Bacterial Ghost Vaccine for Influenza Virus.	0.973	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Bacterial Ghost Vaccine for Influenza Virus.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Flexible Display and Integrated Communication Device for the BAO.	0.973	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Flexible Display and Integrated Communication Device for the BAO.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **7184 Decision Effectiveness & Biosciences**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
(U)	CONGRESSIONAL ADD: Carbon Nanostructured Material for Fluid Purification.	4.866	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Carbon Nanostructured Material for Fluid Purification.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Fused Carbon Nanotube Material for Fluid Purification.	2.432	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Fused Carbon Nanotube Material for Fluid Purification.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Rapid ID and Treatment for Air Force Medical Service.	0.973	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Rapid ID and Treatment for Air Force Medical Service.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Warfighter Pocket XP Project.	4.282	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Warfighter Pocket XP Project.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Networked Warfighter Decision Support.	1.362	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Networked Warfighter Decision Support.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Networked Warfighter Decision Support.				
(U)	In FY 2008: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Bio Medical DNA Program.	0.973	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Bio Medical DNA Program.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Bio Medical DNA Program.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Eyewear Display for Battlefield Operations.	0.973	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Eyewear Display for Battlefield Operations.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Eyewear Display for Battlefield Operations.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Battlefield Automatic Life Status Monitor.	0.000	1.296	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Battlefield Automatic Life Status Monitor.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Miniature Tri-Axial Accelerometer.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Miniature Tri-Axial Accelerometer.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Unmasking Deception and Denial.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Unmasking Deception and Denial.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **7184 Decision Effectiveness & Biosciences**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)					
(U)	Total Cost	68.731	62.682	48.597	47.368

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										
(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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602202F Human Effectiveness Applied Research**	**7757 Bioeffects and Protection**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
7757 Bioeffects and Protection	25.646	26.245	18.235	18.159	19.372	18.260	18.259	18.687	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

The project assesses the bioeffects of directed energy for force protection, special operations, military operations other than war, and peacekeeping applications; and provides tailored/agile human performance optimization technologies to confront asymmetric threats. The project enables the safe operational use of AF aerospace systems through technology developments that ameliorate/counter/exploit the biological effects of operational stressors and other threats. It addresses areas such as safety, risk assessment, mission planning, countermeasures, personnel protection, and counterproliferation research, technology development, and validation.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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.	5.648	6.779	6.354	6.419

(U) In FY 2006: Evaluated impacts of multi-wavelength lasers upon the human visual system. Developed technologies to improve combat vision, including laser eye protection. Completed bioeffects studies and submitted recommendations for revisions to national and international safety standards in the near infrared based on laboratory data and validated models. Explored 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, including human factors methodologies. Provide laser eye protection in an integrated format. Continue to evaluate impacts of multi-wavelength lasers upon the human visual system. Develop robust modeling and simulation programs and first approximations of near real-time probabilistic risk assessment tools. Develop first models of dynamic bi-directional reflectivity distribution function for laser scatter for high energy laser applications.

(U) In FY 2008: Integrate dynamic bi-directional reflectivity distribution mathematical models into diagnostic tools of laser eye damage for collateral hazard assessments of typical laser systems. Expand laser damage threshold database for multiple wavelengths to validate DoD, national, and international safety standards. Evaluate impact of visible lasers upon critical aircrew and ground force missions.

(U) In FY 2009: Perform field and laboratory experiments to verify and validate optical physics model of bi-directional reflectivity distribution calculations for use as high energy laser collateral hazard assessment tool. Integrate collateral hazard assessment software model into airborne laser platform performing high energy laser system demonstrations. Initiate experiments for future high energy laser weapon systems to predict, evaluate, and explore target bioeffects.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)					
(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 development while identifying countermeasures to EM hazards/threats.	5.265	6.570	6.089	5.739
(U)	In FY 2006: Evaluated the bioeffects of emerging directed energy weapons to assess safety and effectiveness. Extended laboratory and field assessment techniques into the terahertz range. Developed new modeling tool to assess potential risks of millimeter waves. Refined modeling and simulation tools to evaluate the human health, behavior, and performance impacts of high frequency EM systems. Evaluated effects of high power and high peak power EM systems using biotechnology. Conducted research to support scientifically-based human exposure standards.				
(U)	In FY 2007: Further refine methods to evaluate the bioeffects of directed energy weapons and support safety and effectiveness assessments of emerging 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)	In FY 2008: Explore tissue interactions from terahertz frequencies to evaluate safe exposure levels and tissue vulnerabilities. Improve EM tissue models to include terahertz and high power EM effects. Continue research to support fielding and effectiveness of radio frequency (RF) directed energy weapon systems.				
(U)	In FY 2009: Conduct experiments to refine and eliminate gaps in RF exposure standards for microwave, ultra-wide band, and high peak power RF systems. Integrate and improve human behavior, bioeffects, and target effects computer models based on RF studies in microwave, ultra-wide band, high peak power, and terahertz sources. Investigate RF bioeffects as a foundation for future RF weapons.				
(U)					
(U)	MAJOR THRUST: Develop biotechnologies to accurately and affordably support the detection, identification, neutralization, and assessment of threat agents. Perform counterproliferation research to enable air operations to continue in the most efficient manner.	3.320	5.624	4.032	3.980
(U)	In FY 2006: Developed technologies to identify the production source of threat agents. Developed methods to assess the viability and activity of threat agents and continued counterproliferation research				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **7757 Bioeffects and Protection**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	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 of threat agents after active countermeasures have been employed. Refine counterproliferation research to better predict and further minimize collateral damage.				
(U)	In FY 2008: Continue to develop and validate methods to assess the viability and activity of threat agents after active countermeasures have been employed. Begin to develop technologies that will enable the AF to locate biological warfare agents behind walls and inside of containers. Characterize organic semiconductor material interactions with directed energy to enhance agent neutralization capabilities.				
(U)	In FY 2009: Refine viability assessment technologies and develop models that predict plume distribution patterns to minimize collateral damage from counterforce weapon detonations. Continue to develop advanced biological taggant technologies that will locate biological warfare agents behind walls and in containers. Investigate counterproliferation technologies capable of effectively neutralizing genetically modified biological threat agents.				
(U)					
(U)	MAJOR THRUST: Develop novel technology solutions integrating behavioral psychology, metabolomic research, nutritional strategies, and personal protective technologies to enable human performance optimization in multiple stressor environments. Results will optimize operational execution through increased human effectiveness, reduced attrition/lost training days, and faster post-mission recovery.	1.366	1.630	1.760	2.021
(U)	In FY 2006: Refined and tested fatigue model to expand performance predictions for additional air and space applications. Identified and assessed novel fatigue countermeasures and associated delivery mechanisms to improve human performance in specific operational aerospace environments. Developed and demonstrated modeling of fatigue interventions.				
(U)	In FY 2007: Investigate individual differences in human performance variability and response to performance optimizing interventions. Extend individual performance research to quantify effects of workload distribution, task novelty, and experience on collaborative team performance in a cognitively demanding environment. Develop methodologies to tailor behavioral and physiological regimens to achieve flexible task-based human performance capabilities.				
(U)	In FY 2008: Continue to develop methodologies to tailor behavioral and physiological regimens and integrate revolutionary concepts in metabolomics/human performance technologies with existing				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	training/operations. Continue research to quantify effects of workload distribution, task novelty, and experience on team performance in a cognitively demanding environment.				
(U)	In FY 2009: Continue development and assess benefit of tailored/agile human performance optimization regimens to confront asymmetric threats. Expand biobehavioral performance models to incorporate individual differences in human performance vulnerability.				
(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. Note: Effort terminates in FY 2007 due to higher AF priorities.	0.414	0.362	0.000	0.000
(U)	In FY 2006: Evaluated advanced materials and innovative design concepts to reduce bulk and thermal burden of aircrew protective equipment. Completed Altitude Decompression Sickness (DCS) math model and transitioned mission planning risk assessment tool to ACC and AFSOC. Quantified 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Genetics of Sleep Deprivation and Fatigue.	0.973	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Genetics of Sleep Deprivation and Fatigue.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Nanoparticles Directed by DNA Capture Elements for the Detection and Neutralization of Bioterrorist Agents.	1.264	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Nanoparticles Directed by DNA Capture Elements for the Detection and Neutralization of Bioterrorist Agents.				
(U)	In FY 2007: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602202F Human Effectiveness Applied Research**	PROJECT NUMBER AND TITLE **7757 Bioeffects and Protection**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Solid Electrolyte Oxygen Separator (SEOS).	4.672	4.284	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for SEOS.				
(U)	In FY 2007: Conduct Congressionally-directed effort for SEOS.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Warfighter Sustainability: Maximizing Human Performance.	2.724	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Warfighter Sustainability: Maximizing Human Performance.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Warfighter Sustainability: Maximizing Human Performance.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	Total Cost	25.646	26.245	18.235	18.159

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification

DATE: **February 2007**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602203F Aerospace Propulsion**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	153.760	218.657	179.161	217.394	222.201	184.034	175.557	179.428	Continuing	TBD
3012	Advanced Propulsion Technology	19.272	29.825	21.984	21.639	23.203	23.141	22.936	23.461	Continuing	TBD
3048	Fuels and Lubrication	20.723	24.599	17.349	26.088	26.678	19.067	17.954	18.301	Continuing	TBD
3066	Turbine Engine Technology	33.107	42.568	51.506	83.546	76.501	46.558	40.753	41.676	Continuing	TBD
3145	Aerospace Power Technology	45.414	44.595	30.784	31.125	35.072	34.205	33.314	34.066	Continuing	TBD
33SP	Space Rocket Component Tech	0.000	58.085	46.819	45.915	48.989	49.192	48.478	49.494	0.000	0.000
4847	Rocket Propulsion Technology	35.244	18.985	10.719	9.081	11.758	11.871	12.122	12.430	Continuing	TBD

Note: In FY 2007, Project 33SP, Space Rocket Component Technology was transferred 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 2007, Project 3012, Advanced Propulsion Technology, combined efforts with a thrust from Project 33SP, Space Rocket Component Technology, in order to more effectively manage cooperative Combined Cycle Engine (CCE) developments. Funds for the FY 2006 Congressionally-directed Notre Dame Center for Flow Physics and Control in the amount of $3.0 million were 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 were moved to PE 0602601F, Space Technology, from PE 0602203F, Aerospace Propulsion, for execution. Funds for the FY 2007 Congressionally-directed High Energy Laser for Detection Inspection and Non-Destructive Testing in the amount of $2.7 million are in the process of being moved to the Defense Advanced Research Projects Agency, from PE 062203F, Aerospace Propulsion, for execution. The funding in this PE has been increased to provide emphasis on component development in support of adaptive cycle technologies, improved fuel efficiency, and highly efficient embedded turbine engines.

(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 six 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 evaluates fuels, lubricants, and combustion concepts and technologies for new and existing engines and directly supports the Versatile Affordable Advanced Turbine Engine (VAATE) program. 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 VAATE program. The Aerospace Power Technology project develops electrical power and thermal management technologies for ground, air, and space military applications that are part of the High Power Aircraft (HiPAC) program. The Space Rocket Component Technology project develops advances in rocket propulsion technologies for space access, space maneuver, and ballistic missiles. The Rocket Propulsion Technology project develops advances in rocket technologies for the sustainment of strategic systems and tactical rockets to include efforts that are part of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) and Technology for the Sustainment Systems (TSSS) programs. Finally, the adaptive cycle technologies project develops component technologies for an adaptive cycle engine architecture to provide optimized performance/fuel efficiency for widely varying mission needs. Note: In FY 2007, Congress added $1.0 million for Advanced High Speed Propulsion Development; $3.9 million for X-51 Robust Scramjet Flight Research; $2.7 million for

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602203F Aerospace Propulsion**

High Energy Laser for Detection Inspection and Non-Destructive Testing; $2.0 million for Ultrafast, Ultraintense Laser Microfabrication and Diagnostics; $1.7 million for Hybrid Bearings; $2.0 million for Research Institute for Environmental Studies (TRIES); $3.9 million for Active Combustion Control System for Military Aircraft; $1.8 million for Active Combustion Control Systems for Military Aircraft; $1.0 million for Advanced Affordability Assurance Tools for the Versatile Affordable Advanced Turbine Engine (VAATE) Initiative; $1.4 million for the Intelligent Engine Technology Development for UAVs; $1.1 million for VAATE TMC FLADE Technology Demonstration; $1.3 million for Advanced Energy Technology for Munititions - Dominator Program; $1.0 million for the Affordable Lightweight Power Supply; $2.5 million for Chemical Hydride Power System; $1.1 million for High Flux ESC System with TES for Military High Energy Laser; $1.0 million for Integrated Electric Starter/Generator; $5.2 million for Manufacturing of High Energy Superior Lithium Battery Technology; $1.3 million for MEPS Thermal Management; $1.0 million for Military Purpose Electrolyte Supported Fuel Cells; $1.4 million for Advanced Liquid Rocket Booster Technology; $3.2 million for Advanced Vehicle and Propulsion Center; $3.6 million for Center for Solar Electricity and Hydrogen; $2.8 million for Engineering Tool Improvement Program (ETIP); $1.6 million for Methane Second Stage Rocket Engine; $1.7 million for Advanced Vortex Hybrid Propulsion System; $1.0 million for Aerospace Lab Equipment Upgrade; and $1.0 million for Solid Boost Propulsion Technology for the Sustainment of Strategic 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 2006	FY 2007	FY 2008	FY 2009
(U) Previous President's Budget	155.673	170.885	159.359	167.671
(U) Current PBR/President's Budget	153.760	218.657	179.161	217.394
(U) Total Adjustments	-1.913			
(U) Congressional Program Reductions				
Congressional Rescissions	-0.018	-0.828		
Congressional Increases		42.600		
Reprogrammings	0.656	6.000		
SBIR/STTR Transfer	-2.551			

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2007**

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

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3012 Advanced Propulsion Technology	19.272	29.825	21.984	21.639	23.203	23.141	22.936	23.461	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2006 and FY 2007, funding was increased to accelerate efforts to develop technologies to support an Air Force scramjet effort. In FY 2007, Project 3012, Advanced Propulsion Technology, absorbed Combined Cycle Engine (CCE) efforts from Project 33SP, Space Rocket Component Technology, in order to more effectively manage cooperative CCE developments.

(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 2006	FY 2007	FY 2008	FY 2009
(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. Note: In FY 2006 and FY 2007, funding supports significant ground testing that will wrap up in FY 2007.	7.575	12.109	1.188	1.245

(U) In FY 2006: Developed and demonstrated flight weight engine components and a control system with closed loop controller. Tested flight weight scramjet engine with flight weight fuel control valves and closed loop engine controls at Mach 5. Performed trajectory optimization for flight test. Evaluated 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. Verified operation of engine control techniques, based on rapid shock train identification/ characterization coupled with fuel control logic, to ensure stable scramjet operation. Designed, fabricated, and initiated 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 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

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	test risk.				
(U)	In FY 2008: Continue development and demonstration of flight weight engine components and advanced engine control logic. 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. Initiate design and testing of advanced scramjet start techniques. 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.				
(U)	In FY 2009: Continue development and demonstration of flight weight engine components and advanced engine control logic. 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. Complete ground testing of advanced scramjet start techniques. 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.				
(U)					
(U)	MAJOR THRUST: Conduct assessments, technology 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.	1.062	2.239	1.991	2.371
(U)	In FY 2006: Performed trade studies to determine military payoff and establish component technology goals. Defined component and engine performance objectives to enable development of affordable hypersonic flight demonstrators jointly with NASA and DARPA. Developed advanced components for turbine-based and rocket-based CCEs, with initial emphasis on advanced inlets for turbine-based CCEs capable of operating from Mach 0 to Mach 8. Designed sub-scale inlet test article.				
(U)	In FY 2007: Continue 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 from Mach 0 to Mach 8.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602203F Aerospace Propulsion**	PROJECT NUMBER AND TITLE **3012 Advanced Propulsion Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Continue 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. Complete testing of advanced inlets for turbine-based CCEs capable of operating from Mach 0 to Mach 8. Design an advanced nozzle for turbine-based and rocket-based CCEs.				
(U)	In FY 2009: Continue 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. Conduct testing of advanced nozzles for turbine-based and rocket-based CCEs.				
(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. Note; Starting in FY 2008, efforts shift towards much larger hot section testing and voluminous test data will be required to correlate the combustion scaling phenomena to the original baseline configuration to provide the knowledge to scale the scramjet configuration to larger applications potentially up to space launch.	9.665	10.595	18.805	18.023
(U)	In FY 2006: Developed advanced engine components to improve scramjet operating margin and to establish scramjet scaling laws for reusable applications. Developed variable geometry techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Fabricated and initiated test of scramjet combustors sized for reusable applications with improved structural efficiency. Developed 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)	In FY 2008: Continue development of advanced engine components to improve scramjet operating margin and to establish scramjet scaling laws for reusable applications. Continue development of				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	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 5 to 10 times baseline size 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)	In FY 2009: Continue development of advanced engine components to improve scramjet operating margin and to establish scramjet scaling laws for reusable applications. Complete development of variable geometry techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Continue sector testing of large scale scramjet combustors 20 to 50 times baseline size for reusable applications with improved structural efficiency. Continue 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.	0.970	0.000	0.000	0.000
(U)	In FY 2006: Implemented improvements supporting 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced High Speed Propulsion Development.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Enhance the nation's ability to test and analyze high speed propusion systems such as scramjets and combined cycle engines.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: X-51 Robust Scramjet Flight Research.	0.000	3.886	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Investigate the integration of alternative high speed combined cycle engine configurations				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602203F Aerospace Propulsion**	PROJECT NUMBER AND TITLE **3012 Advanced Propulsion Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	(such as circular and rectangular scramjets) for potential flight demonstration under X-51 follow-on efforts.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	19.272	29.825	21.984	21.639

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 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										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

Committee.

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602203F Aerospace Propulsion**	PROJECT NUMBER AND TITLE **3048 Fuels and Lubrication**	

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3048 Fuels and Lubrication	20.723	24.599	17.349	26.088	26.678	19.067	17.954	18.301	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: The funding in this project has been increased to provide emphasis on component development in support of adaptive cycle technologies. Funds for the FY 2007 Congressionally-directed High Energy Laser for Detection Inspection and Non-Destructive Testing in the amount of $2.7 million are in the process of being moved to the Defense Advanced Research Projects Agency, from PE 062203F, Aerospace Propulsion, for execution.

(U) A. Mission Description and Budget Item Justification

This project evaluates 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. 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. A portion of this project supports adaptive cycle technologies. This effort develops component technology for an adaptive cycle engine architecture that provides optimized performance/fuel efficiency for widely varying mission needs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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. Determine fuel cooling requirements and specifications for an adaptive cycle engine architecture. Design, fabricate, and test of key thermal management technologies. Note: Increased funding in FY2008 and out due to emphasis on component development in support of adaptive cycle technologies.	1.751	2.162	3.053	6.764

(U) In FY 2006: Conducted 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. Developed initial engine thermal management models, aiming toward system-level models of advanced aircraft. Developed 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.

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: 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 fuels, and improved materials and coatings. Continue effort to validate component performance models on aircraft thermal management simulator. Complete the development of approaches to assess and improve additive combustion behavior at low fuel and air temperatures. Continue to test fuel candidates in bench scale rigs simulating advanced high Mach propulsion systems and the Highly Efficient Embedded Efficient Turbine Engine. Develop a robust mechanical and integrated engine thermal management system (mechanical and fuel systems) for optimum engine performance and durability at sustained supersonic cruise conditions.				
(U)	In FY 2009: 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. Continue effort to validate component performance models on aircraft thermal management simulator. Continue to test fuel candidates in bench scale rigs simulating advanced high Mach propulsion systems and the Highly Efficient Embedded Turbine Engine. Conduct full-scale component rig testing of mechanical components with prototype lubricants. Conduct simulated high-Mach tests of an integrated thermal management system and mechanical system components.				
(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.	1.085	1.339	1.273	1.721
(U)	In FY 2006: Assessed novel fuel additives including nano-technologies and fuels derived from alternative energy resources to reduce emissions in laboratory scale combustion rigs. Developed 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)	In FY 2008: Complete assessing novel fuel additives including nano-technologies to reduce emissions in laboratory scale combustion rigs. Initiate improvement of combustion models for kerosene fuels. Continue higher-pressure measurements of additive and fuel effects on sub-micron particulate generation during combustion.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2009: Continue higher-pressure measurements of additive and fuel effects on sub-micron particulate generation during combustion. Initiate study of NOx/soot tradeoffs in combustor design. Continue improvement of combustion models for kerosene fuels				
(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.	1.085	1.339	1.273	1.721
(U)	In FY 2006: Assessed fuel additives optimization for logistics footprint reduction. Investigated performance of Fischer-Tropsch (F-T) and other alternative fuels for aircraft and other field hardware. Completed investigation of supply chain biological contamination and the impact on fuel logistics. Evaluated nano-technology fuel sensors and biological mitigation techniques. Completed 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)	In FY 2008: Expand investigation of the performance of alternative fuels to include bio-derived fuels. Initiate development of bioreactors to simulate biological growth in aircraft fuel systems and ground storage facilities. Initiate development of knowledge base for certification of Fischer-Tropsch fuels for all Air Force tactical vehicles Continue evaluation of advanced nano-technology fuel sensors, nano-technology fuel additives, and novel detection and mitigation technologies for biological growth.				
(U)	In FY 2009: Continue to investigate performance of biomass-derived fuels for aircraft and other field hardware. Initiate extension of knowledge base to other alternative fuels, such as those derived from biomass. Continue development of bioreactors to simulate biological growth in aircraft fuel systems and ground storage facilities. Continue development of knowledge base for certification of Fischer-Tropsch fuels for all Air Force tactical vehicles.				
(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.	0.543	0.670	0.637	0.861
(U)	In FY 2006: Assessed 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				

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	conditions. Collect improved fuel property data for hydrocarbon propellant database.				
(U)	In FY 2008: Complete study of refined kerosene propellants under high heat flux conditions, while continuing to study synthesized high-energy hydrocarbons. Continue to improve fuel property database and share with industry to improve design tools.				
(U)	In FY 2009: Continue study of high-energy hydrocarbon propellant candidates. Complete improved physical property database for kerosene propellants at high pressure. Continue to collect improved physical property for high energy hydrocarbons and improve physical property models.				
(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.	3.781	4.695	4.436	5.996
(U)	In FY 2006: Evaluated advanced combustion system performance at realistic operating conditions. Investigated larger-scale inter-turbine burner concepts at relevant engine operating conditions to increase mission flexibility. Developed a Pulse Detonation Engine (PDE) turbine-based hybrid concept. Conducted experiments to validate chemical kinetics of practical fuels at high pressure and temperature. Performed 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. Evaluated and developed 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)	In FY 2008: Demonstrate small-scale inter-turbine burner (ITB) concepts in a relevant engine environment. Investigate the scalability of inter-turbine burners for large engines. Assess an integrated pulsed detonation/hybrid turbine concept performance with component fabrication and evaluation. Investigate combustor and augmentor systems for high-altitude low-high mach applications. Evaluate and optimize advanced combustor, augmentor, and PDE concepts using modeling and simulation tools.				
(U)	In FY 2009: Evaluate advanced combustion system performance at realistic operating conditions. Demonstrate small-scale ITB concepts in small engine. Identify concept designs of inter-turbine burning concepts for large gas turbine engines. Optimize component efficiency of the integrated pulsed				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	detonation/hybrid turbine. Evaluate and optimize advanced combustor, augmentor, and PDE concepts using modeling and simulation tools covering wider flight conditions and applications.				
(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.	0.543	0.670	0.637	0.861
(U)	In FY 2006: Evaluated, at a laboratory scale, approaches to improve fuel heat sink and provide thermal management capability for high speed systems. Evaluated surface/catalyst effects on coke reduction to improve fuel heat sink capability and increase fuel system life. Assessed 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)	In FY 2008: Evaluate improved coke-mitigating surfaces/catalysts with 2nd generation endothermic fuels in bench-scale heat exchanger rigs. Assess unconventional approaches to increase fuel heat sink and minimize regenerative cooling heat loads in panel tests. Initiate study of relationship between fuel structure/properties and combustion behavior including blowout.				
(U)	In FY 2009: Continue bench-scale tests to evaluate improved surfaces/catalysts for 2nd generation endothermic fuels. Continue assessment of unconventional approaches to increase fuel heat sink and minimize regenerative cooling heat loads. Continue study of relationship between fuel structure/properties and combustion behavior including blowout.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for application to revolutionary propulsion technologies.	0.681	0.840	0.799	1.080
(U)	In FY 2006: Applied advanced laser diagnostics for accurate measurements inside advanced gas turbine combustion systems to improve design cycle time. Developed sensor technologies for use in intelligent gas turbine engine combustion systems for enhanced operability, increased durability and performance. Investigated 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)	In FY 2008: Demonstrate high-bandwidth (e.g., MHz-rate) planar laser-induced fluorescence for				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	high-speed digital imaging of key combustion species in fundamental laboratory flames and relevant engine environments. Apply terahertz radiation (T-rays) for combustion temperature sensing and non-destructive inspection/evaluation of turbine engine components. Integrate current and next-generation combustion diagnostics to support RDT&E of augmentor solutions for fighter aircraft.				
(U)	In FY 2009: Develop high-speed techniques for measuring carbon monoxide (CO) to evaluate CO oxidiation/combustion efficiency in near-constant-volume-combustion turbine environments. Exploit ultrafast (e.g., femtosecond), ultraintense (e.g., terawatt) laser systems to generate ultrashort x-ray bursts for soot-mitigation studies and dense-fuel-spray imaging. Develop multi-pulse femtosecond ballistic imaging to understand and improve fuel sprays in combustor, augmentor, scramjet, and rocket applications.				
(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.	2.105	2.598	2.470	3.339
(U)	In FY 2006: Developed and tested advanced bearing and lubrication system concepts, components, and materials for improved engine performance, affordability, and engine health monitoring, which are applicable to man-rated, expendable, and Unmanned Aerial Vehicle (UAV) turbine engines. Testing focused on enhanced 5 centiStokes (cSt) high thermal stability (HTS) lubricant candidates and new elastomer compatibility test method. Designed test approaches for enhanced high thermal stability oils for new, legacy, and commercial turbine engines. Developed Technology Development Roadmap for 7cSt ester lubricant for high Mach/high temperature military and commercial turbine engines. Tested prototype Joint Oil Program (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. Initiate 7cSt 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.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602203F Aerospace Propulsion**	PROJECT NUMBER AND TITLE **3048 Fuels and Lubrication**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Complete qualification testing of the enhanced 5cSt ester candidate(s), transition to demo engine program and draft new oil specification. Ramp up qualification testing of hi-mach 7cSt ester in preparation of FY11 engine demo. Develop an integrated and effective bearing / oil health monitoring system with prognostics capability to address critical DoD safety, readiness, and life-cycle cost concerns. Conduct technology assessment of long-term, low-temperature (hi-altitude) performance of engine lubricants and develop concepts for efficient mechanical system for highly efficient embedded turbine engines.				
(U)	In FY 2009: Finalize and field new enhanced 5cSt oil specification. Conduct qualification testing of new hi-mach 7cSt ester lubricant. Demonstrate an integrated bearing / oil health monitoring / prognostic system in full-scale setting and validate life models. Fabricate and test an efficient mechanical system for highly efficient embedded turbine engine.				
(U)					
(U)	MAJOR THRUST: Develop and test advanced bearing material technology and bearing concepts for small, intermediate, and large-sized turbine engine applications.	2.361	2.914	2.771	3.745
(U)	In FY 2006: Conducted airfoil bearing testing of large shaft diameter sizes to determine load capacity and rotor size limitations of this technology. Developed and tested affordable rotor support technology for small-, intermediate-, and large-sized turbine engine applications. Improved modeling and simulation tools for advance design, which will shorten development time, and reduce test requirements for mechanical and electromagnetic rotor support and power generation systems. Modeled airfoil bearings for advanced engine rotor support and power generation. Initiated full-scale tests of hybrid (metal/ceramic) bearing technology for the new fighter demonstrator engines with lubricant from the JOP. Studied mechanical systems and thermal management concepts for turbo accelerators in combined cycle engines.				
(U)	In FY 2007: Conduct airfoil bearing tests in larger shaft diameter sizes to determine load capacity and rotor size limitations of this technology. Develop and test of affordable rotor support technology for small-, intermediate-, and large-sized turbine engine applications. Validate modeling and simulation tools 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. Transition/transfer airfoil bearing technology to bearing and engine companies. Demonstrate hybrid (metal/ceramic) bearing and JOP lubricants in new fighter demonstrator engines. Initiate programs for hardware needed for optimum thermal protection designs for high mach/high				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	temperature turbine engines and accelerators. Expand the previous studies of advanced rotor support and power generation for turbine and combined cycle engines.				
(U)	In FY 2008: Demonstrate new fatigue and spall propagation resistant bearing materials in advanced demo engines with enhanced 5cSt oil. Conduct subscale fatigue life and spall propagation studies of bearing materials with hi-mach 7cSt oil candidates. Develop preliminary design of propfan gearbox and conduct trade study of energy efficient mechanical system components (ie. rolling element vs. foil vs. magnetic bearing) for highly efficient embedded turbine engine.				
(U)	In FY 2009: Complete subscale fatigue life and spall propagation studies of bearing materials with hi-mach 7cSt oil candidates and begin full-scale tests. Fabricate and test propfan gearbox. Down select mechanical system components and complete detailed design for highly efficient embedded turbine engine.				
(U)					
(U)	CONGRESSIONAL ADD: Ultrafast, Ultraintense Laser Microfabrication and Diagnostics (formerly Intense, Ultrafast Laser Microfabrication and Diagnostics).	1.358	0.996	0.000	0.000
(U)	In FY 2006: Developed technology to exploit characteristics of intense, ultrafast lasers for sensors and weapons systems. Investigated these systems for use in gas turbine engine diagnostics. Developed 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: Continue to establish the technical base required to evaluate and develop ultrafast, ultraintense lasers for fabrication, inspection, and repair of components for aerospace propulsion and other weapon systems.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Wavelength Agile Spectral Harmonic Oxygen Sensor.	0.970	0.000	0.000	0.000
(U)	In FY 2006: Designed, fabricated, and tested a second generation oxygen sensor to measure oxygen concentration in high-performance fuel tanks. Conducted environmental testing of the sensor under simulated fuel tank conditions and performed Category A flight testing to aid in modification of the design, resulting in a third generation sensor design. Also conducted an evaluation of second generation sensor specifications and certification plan.				
(U)	In FY 2007: Not Applicable.				

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Hybrid Bearings.	2.036	1.694	0.000	0.000
(U)	In FY 2006: Developed advanced hybrid bearing technology for use in high performance turbine engines. Conducted bearing fatigue life testing of advanced Pyrowear 675 (P675) hybrid bearings and P675 heat treatment optimization and characterization. Developed critical flaw models for Silicon Nitride (Si3N4) bearing balls, and experimentally validated models. Also, investigated advanced Non-destructive Evaluation (NDE) methods for Si3N4 bearing balls and conducted full-scale bearing performance testing of advanced hybrid bearings. Note: Moved to PE 0602203F from PE 0603112.				
(U)	In FY 2007: Develop a suite of advanced hybrid bearing technologies for transition to JSF thrust growth and advanced VAATE turbine engines.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Pulse Detonation Engine (and Laser Induced Thermal Acoustics Instrument).	2.424	0.000	0.000	0.000
(U)	In FY 2006: Worked to enhance capability to demonstrate detonation initiation techniques in an integrated test rig. Conducted test firings with multiple detonation initiation methods in parallel attempting to provide technology risk reduction and alleviate detonation initiation difficulties.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Research Institute for Environmental Studies.	0.000	1.992	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Accelerate the development and demonstration of a modular, portable wastewater treatment system that can meet EPA standards and can be deployed to forward bases within 24 hours.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: High Energy Laser for Detection Inspection and Non-Destructive Testing	0.000	2.690	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)					
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop high-energy laser techniques for use as a non-destructive technique for inspection of gas turbine engine components.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	20.723	24.599	17.349	26.088

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602203F Aerospace Propulsion**	PROJECT NUMBER AND TITLE **3066 Turbine Engine Technology**	

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3066 Turbine Engine Technology	33.107	42.568	51.506	83.546	76.501	46.558	40.753	41.676	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: The funding in this project has been increased to provide emphasis on adaptive cycle technologies, increased fuel efficiency, and highly efficient embedded turbine engines. Funds for the Fiscal Year 2006 Congressionally-directed Notre Dame Center for Flow Physics and Control in the amount of $3.0 million were 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 Versatile Affordable Advanced Turbine Engine (VAATE) program, which is a 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. A portion of this project supports adaptive cycle technologies . This effort develops component technology for an adaptive cycle engine architecture that provides optimized performance/fuel efficiency for widely varying mission needs. A portion of the project supports the Energy Conservation - Assured Fuels Initiative. This effort identifies, develops and demonstrates technologies that enable the use of domestic fuel sources for military energy needs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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. Identify, develop and demonstrate technologies that enable the use of domestic fuel sources for military energy needs. Develop advanced concepts, designs, design rules, and computational tools to support component research and rig testing of components for an adaptive cycle engine. Develop advanced concepts, designs, design rules, and computational tools to support research and rig testing of component technologies to substantially improve specific fuel consumption by increasing overall pressure ratio and turbine rotor inlet temperature; by improving component efficiencies; and by reducing cooling air and pressure losses. Note: Increased funding in FY 2008 and out due to emphasis on increased fuel efficiency, adaptive cycle technologies, and highly efficient embedded turbine engines.	16.200	17.700	33.664	60.113

(U) In FY 2006: Developed and applied 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.). Incorporated advanced materials systems into innovative designs (gamma titanium aluminides, metal matrix composites, ceramics, new metallic alloys, etc.). Developed and extended analytical methods to predict integrally bladed rotor and airfoil

(U) B. Accomplishments/Planned Program ($ in Millions) FY 2006 FY 2007 FY 2008 FY 2009

durability, and damage tolerance. Conducted bench and rig tests of advanced components for validation, including 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 into innovative designs and analyze Ceramic Matrix Composite (CMC) 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) In FY 2008: Continue to develop and apply advanced modeling and simulation rules and tools for advanced components. Develop and optimize novel dual fuel burner. Determine suitability of latest Titanium Aluminide materials for Mach 4 compressor application. Develop and apply advanced modeling and simulation rules and tools to significantly improve component efficiencies, enabling reduced fuel consumption in emerging and future gas turbine propulsion systems. Develop and apply advanced modeling and simulation rules and tools to initiate definition and design of lightweight, simple, adaptive cycle features. Develop and apply advanced modeling and simulation rules and tools to initiate definition and design of an efficient, wide-flow range compressor. Develop and apply advanced modeling and simulation rules and tools to initiate definition and design of an efficient, very high pressure ratio compressor and associated thermal management features that will offer a step change improvement in engine SFC.

(U) In FY 2009: Continue to develop and apply advanced modeling and simulation rules and tools for advanced components. Conduct rig testing of advanced high pressure turbine vane and blade nano-laminate thermal barrier coating (TBC) applied. Begin to develop computational fluid dynamics methodology for analyzing turbine flows. Begin to develop CMC lifing models. Conduct bench and rig tests for validation of components with significantly improved efficiency. Conduct rig testing of lightweight, simple, adaptive cycle features, an efficient, wide-flow range compressor, an efficient, high temperature turbine capable of operating over large swings in required work, and an efficient, lightweight, LO-compatible exhaust system. Fabricate and rig test an efficient, very high pressure ratio compressor and associated thermal management features that will offer a step change improvement in engine SFC.

(U)

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602203F Aerospace Propulsion**	PROJECT NUMBER AND TITLE **3066 Turbine Engine Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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.	10.311	11.000	12.486	16.524
(U)	In FY 2006: Developed and applied 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.). Applied advanced materials systems to innovative designs (gamma titanium aluminides, metal matrix composites, ceramics, advanced metallic alloys, etc.). Developed new and innovative design concepts, and conducted 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 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)	In FY 2008: Continue to develop and apply advanced modeling and simulation rules and tools for advanced components. Conduct risk reduction testing of variable bypass ratio fan concept. Develop and rig test reheat augmentor technology to significantly decrease burning length. Design and fabricate an advanced lightweight, variable area exhaust nozzle.				
(U)	In FY 2009: Continue to develop and apply advanced modeling and simulation rules and tools for advanced components. Develop durable damping/erosion coating systems. Conduct rig testing of advanced fan design for application to a variable cycle engine concept.				
(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.	3.278	3.530	3.969	5.188
(U)	In FY 2006: Completed 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. Applied advanced materials to innovative designs and analyze a slinger-fed, dual-fuel compact recirculation combustor (CRC).				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Developed and applied 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.). Completed detailed design, computational fluid dynamics, and performed analyses for a fuel-cooled turbine. Developed new and innovative design concepts, and conducted 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)	In FY 2008: Utilize data from high speed turbine engine testing of a wide-range, lightweight carbon-carbon variable area exhaust nozzle and a compact, carbon-carbon ramburner to update and validate advanced modeling and simulation rules and tools.				
(U)	In FY 2009: Utilize data from high speed turbine engine testing of a fuel cooled turbine and a slinger-fed, dual-fuel CRC to update and validate advanced modeling and simulation rules and tools.				
(U)					
(U)	MAJOR THRUST: Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.	1.088	1.173	1.387	1.721
(U)	In FY 2006: Developed and applied 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.). Completed 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. Applied advanced materials systems to design and analyze a high heat release combustor. Developed new and innovative design concepts and conducted 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 for validation of a high heat release combustor design and an advanced forward swept, centrifugal compressor design.				
(U)	In FY 2008: Develop new and innovative design concepts and conduct bench and rig tests for validation of a mixed flow turbine design.				
(U)	In FY 2009: Utilize data from efficient small scale engine testing of an advanced forward swept,				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	centrifugal compressor and a silicon nitride mixed flow turbine to update and validate advanced modeling and simulation rules and tools.				
(U)					
(U)	CONGRESSIONAL ADD: VAATE TMC FLADE Technology Demonstration (formerly VAATE-Titanium Matrix Composites).	1.745	1.096	0.000	0.000
(U)	In FY 2006: Utilized previous Titanium Matrix Composites (TMC) modeling predictions to evaluate design options for a TMC advanced fan blisk for application to a variable cycle engine.				
(U)	In FY 2007: Continue development of Titanium Matrix Composites for advanced turbine engine components.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Intelligent Engine Software Development for Advanced Turbine Engines.	0.485	0.000	0.000	0.000
(U)	In FY 2006: Developed a generic, model-based reasoning software product that includes the model representation and implementation process, as well as the generic reasoning algorithm suite that can traverse the model for ground-based troubleshooting and fault isolation applications. Developed specific modeling toll interfaces that allow the generic reasoning algorithms to work with different modeling approaches and data structure, such as the DSI eXpress model that is currently used in various Air force programs. Conducted research related to P-SAR and Multi-service implementations. Developed and implemented an automated learning process and algorithm suite that will allow the fault/failure mode and maintenance task reasoners to improve over the life cycle of the product. Selected and developed a specific engine model for use with the reasoning algorithms.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Active Combustion Control System for Military Aircraft.	0.000	3.885	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop advanced Active Combustion Control System (ACCS) components for use in ongoing and future engine development programs.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)					
(U)					
(U)	CONGRESSIONAL ADD: Active Combustion Control Systems for Military Aircraft.	0.000	1.793	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop advanced active combustion control system components for use in ongoing and future engine development programs.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Affordability Assurance Tools for the Versatile Affordable Advanced Turbine Engine (VAATE) Initiative.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop state-of-the-art computer software tools that will estimate development, production, and maintenace costs for advanced technology turbine engines.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Intelligent Engine Technology Development for UAVs.	0.000	1.395	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop turbine engine life management software to reduce overall engine maintenance costs.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	33.107	42.568	51.506	83.546

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Materials:										
(U)	PE 0601102F, Defense Research Sciences.										
(U)	PE 0602102F, Materials.										
(U)	PE 0603216F, Aerospace Propulsion and Power										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

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 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE **February 2007**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602203F Aerospace Propulsion**	**3145 Aerospace Power Technology**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3145 Aerospace Power Technology	45.414	44.595	30.784	31.125	35.072	34.205	33.314	34.066	Continuing	TBD
Quantity of RDT&E Articles	0	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 were 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 were moved to PE 0602203F, Aerospace Propulsion, from PE 0602602F, Conventional Munitions, for execution.

(U) A. Mission Description and Budget Item Justification

This project develops electrical and thermal management technologies for military aerospace applications. Power component technologies are developed to increase reliability, maintainability, commonality, affordability, and supportability of aircraft and flight line equipment. Research is conducted in energy storage and hybrid power system technologies to enable special purpose applications. Electrical power and thermal management technologies enable all future military directed energy weapon systems. This project supports development of electrical power and thermal management component and systems suitable for applications to legacy and future aircraft platforms including strike and mobility concepts. Lightweight power systems suitable for other aerospace applications are also developed.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop electrical power and thermal management component and subsystem technologies for manned and unmanned aircraft systems. These technologies improve aircraft range, self-sufficiency, reliability, maintainability, and supportability, while reducing life cycle costs and enabling new capabilities. Develop hybrid electrical power and thermal management, including energy conversion/storage, components and subsystem technologies for special purpose applications enabling long endurance missions. Note: Increased funding in FY 2008 due to emphasis on component development in support of electric hybrid special programs.	11.053	11.614	16.531	17.345
(U) In FY 2006: Developed next generation solid state lithium-based electrolyte and developed thin film cells with high voltage battery cathodes. Performed system design and analysis and developed breadboard of a high power fuel cell 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. Complete preliminary aircraft thermal management studies and identify high efficiency design candidates.				
(U) In FY 2008: Develop and design high efficiency, high power, high temperature power electrical components. Develop and test air vehicle electromagnetic and radio frequency effects immune components. Design and fabricate thermal management components and subsystems. Initiate studies, modeling & simulation, and develop preliminary designs for energy harvesting and energy dense, long endurance battery and fuel cell components and subsystems. Develop and test rechargeable/refuelable,				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	lightweight, energy dense, high power hybrid battery, fuel cell and power management components and subsystems.				
(U)	In FY 2009: Fabricate, integrate, and test high efficiency, high power, high temperature power electrical components. Initiate integration and test air vehicle electromagnetic and radio frequency effects immune components. Integrate and test thermal management components and subsystems. Integrate and initiate subsystems test of flight-weight, efficient, energy harvesting, hybrid battery and fuel cell components.				
(U)					
(U)	MAJOR THRUST: Develop electrical power and thermal management, energy conversion/storage and power conditioning components, and subsystem technologies for aerospace applications. Note: In FY 2007, this activity will be completed.	4.146	3.997	0.000	0.000
(U)	In FY 2006: Completed testing a silicon carbide packaging concept for power electronic device development. Scaled-up sub-scale spray cooling flight tests to ten kilowatt (kW) and expanded modeling efforts to support the scale-up. Developed 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop lightweight electrical power and thermal management component and subsystem technologies with low volume displacement to enable delivery of high power for operation of directed energy weapons.	14.020	14.638	14.253	13.780
(U)	In FY 2006: Developed conductor configuration, tested, and delivered a coil of alternating current tolerant high temperature superconducting material. Initiated preliminary design of high rate lithium-ion (liquid) battery system for directed energy applications. Completed design of proof-of-concept superconducting generator and began 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)	In FY 2008: Develop and initiate design of a flight-weight superconducting generator, high rate charge/discharge energy storage and high voltage/current components and subsystems. Develop concept designs for superconducting multimegawatt generator.				
(U)	In FY 2009: Complete design and fabrication of superconducting generator, energy storage and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602203F Aerospace Propulsion**	PROJECT NUMBER AND TITLE **3145 Aerospace Power Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	conditioning components and subsystems.				
(U)					
(U)	CONGRESSIONAL ADD: Cell-Level Battery Control.	0.970	0.000	0.000	0.000
(U)	In FY 2006: The individual Application Specific Integrated Circuits and controller were integrated with 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Center for Security of Large-Scale Systems.	1.358	0.000	0.000	0.000
(U)	In FY 2006: Developed optimization strategies, prognostics, and health monitoring (PHM) systems for military platforms. Applied Distributed Heterogeneous Optimization (DHO) and PHM to prospective military platforms with specific focus on near-space vehicles and more-electric power-optimized aircraft. Conducted tests and used prototype hardware to validate DHO and PHM strategies.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Integrated Power and Aircraft Technologies.	5.139	0.000	0.000	0.000
(U)	In FY 2006: Developed and demonstrated an integrated power unit (IPU) as a multi-function turbogenerator with maximized power density (kW/ft3) and minimized logistics requirements. Designed and demonstrated an engine-internal generator(s) for propulsion engines for an unmanned aircraft. Developed technologies for superconducting generators of 1-5 Megawatt (MW) power range with minimized size/weight requirements for a generator and its cryocooling subsystem. Developed 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. Developed 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. Designed, built, and demonstrated various components supporting an "all-electric engine" that does not require an external gearbox drive or its accessories.				
(U)	In FY 2007: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602203F Aerospace Propulsion**	PROJECT NUMBER AND TITLE **3145 Aerospace Power Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: High Flux ESC System with TES for Military High Energy Laser.	1.261	1.096	0.000	0.000
(U)	In FY 2006: Developed spray cooling technology critical for cooling high heat flux tactical lasers on space and air vehicles. Evaluated scalability and reliability of the evaporative spray cooling thermal management system. Scaled TMS to cool up to 30 kW of waste heat with an energy storage capacity of 2 Megajoules. Designed and evaluated cooling system to operate in harsh environmental conditions such as variable gravity and extreme temperatures.				
(U)	In FY 2007: Continue development of evaporative spray cooling techniques for cooling high heat flux tactical lasers.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Affordable Lightweight Power Supply Development.	1.745	0.996	0.000	0.000
(U)	In FY 2006: Demonstrated a novel membrane electrode assembly (MEA) employing advanced electrolyte and/or catalysts with vastly superior performance compared to conventional MEA's at high temperatures and low relative humidity. Further developed these components to improve longevity and mechanical integrity under harsh operating conditions. Constructed and tested MEA's 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: Continue to develop alternative high performance electrolytes and low-cost MEA's, which are capable of operating at high temperatures, zero or reduced humidities and which enable decreased system complexity and improved utilization of high energy fuels.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: MEPS (Multimegawatt Electric Power System) Thermal Management.	1.358	1.295	0.000	0.000
(U)	In FY 2006: Performed 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. Performed a sub-scale thermal management demonstration of the heat removal technique. Developed a technique that prevents over-temperature damage from occurring to the				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	microwave device in the event that the cooling technique ceases to function properly.				
(U)	In FY 2007: Continue the development of a multimegawatt electric power system.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Chemical Hydride Power System (formerly Portable Power Solution Employing Chemical Hydrides).	1.649	2.491	0.000	0.000
(U)	In FY 2006: Aided transition of the fuel cell power unit to the Battlefield Renewable Integrated Tactical Energy System (BRITES) through continued refinement of the energy storage cartridge. Various aspects of the cartridge performance were examined with respect to orientational dependence, ruggedness, and cost effectiveness. Multiple cartridges were constructed and evaluated and a detailed analysis of their performance and reliability was presented. Additionally, advanced methodologies for increasing cartridge energy density were explored. In particular, non-aqueous fuel hydrolysis was examined.				
(U)	In FY 2007: Further develop the technologies necessary to improve the reliability and compactness of chemical hydride replacement cartridges for Airman portable power systems.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Energy Technology for Munitions - Dominator Program	2.715	1.295	0.000	0.000
(U)	In FY 2006: Developed lightweight fuel cell stack materials to increase system power density. Additional goalsinclude development of lightweight recuperators, heat exchanges, and cathode air blowers. Advanced fuel processing catalysts that are capable of logistic fuel operability were also studied.				
(U)	In FY 2007: Continue development of a compact, flight weight solid oxide fuel cell based power system for the Area Dominator munition.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Integrated Electrical Starter/Generator	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop technologies necessary to raise the technology readiness level of integral				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	starter/generators. Efforts will include a detailed design of a production-configuration Inverter-Converter Controllers (ICCs).				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Manufacturing of High Energy Superior Lithium Battery Technology	0.000	5.181	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop the Superior Lithium Polymer Battery (SLPB) technology for a 5, 28 and 270 VDC advanced military aircraft battery with a goal cycle life equal to 5000 cycles at 80 percent Depth of Discharge.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Military Purpose Electrolyte Supported Fuel Cells	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop high power dense advanced solid oxide fuel cell stack technology for UAV applications. Specific objectives include stack scale-up, internal reformation development, and system modeling.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	45.414	44.595	30.784	31.125

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602203F Aerospace Propulsion**	PROJECT NUMBER AND TITLE **3145 Aerospace Power Technology**

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

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 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
33SP Space Rocket Component Tech	0.000	58.085	46.819	45.915	48.989	49.192	48.478	49.494	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2007, efforts were transferred from PE 0602500F, Multi-Disciplinary Space Technology, Project 5026, Rocket Propulsion Component Tech, and Project 5027, High Speed Airbreathing Propulsion Technologies, to this Project in order to more effectively manage and provide oversight of the efforts. In FY 2007, Project 3012, Advanced Propulsion Technology, absorbed the efforts of a thrust from Project 33SP, Space Rocket Component Technology, in order to more effectively manage cooperative Combined Cycle Engine (CCE) developments.

(U) A. Mission Description and Budget Item Justification

This project develops advances in rocket propulsion technologies for space access, space maneuver, tactical 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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop, characterize, and test advanced hydrocarbons, energetics, solid propellant ingredients, 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; development of supporting computational tools; 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	3.602	3.989	4.581
(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.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Continue to model and analyze advanced propulsion concepts with enhanced performance and reliability such as rocket-based combined cycle engines.				
(U)	In FY 2008: Initiate evaluation and development of potential hydrocarbon fuel additives to improve performance of kerosene. Continue downselect process and continue scaling-up promising high energy-density materials candidates. Develop new high engergy-density, high nitrogen ingredients. Develop proof of concept for new computational code to predict molecular properties of propellant ingredients. Evaluate scaled-up propellants in advanced combustion devices to determine materials compatibility and performance to include supporting large-scale motor tests. Continue exploration and development of ionic liquids meeting Phase III goals.				
(U)	In FY 2009: Continue evaluation and development of potential hydrocarbon fuel additives to improve performance of kerosene. Continue downselect process and continue scaling-up promising high energy-density materials candidates. Continue development and characterization of high nitrogen ingredients. Evaluate scaled-up propellants in advanced combustion devices to determine materials compatibility and performance to include supporting large-scale motor tests. Continue exploration and development of ionic liquids meeting Phase III goals. Initiate scale up of promising ionic liquids for further characterization. Continue proof of concept for new computational code to predict molecular properties.				
(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	7.861	8.126	6.003
(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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

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) In FY 2008: Characterize, study, and evaluate shear coaxial injector performance to ensure chamber/injector compatibility and prevent damage to upper stage engines. 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. Conduct validation and verification of advanced multi-phase modeling and simulation (M&S) capabilities. Perform pre-selection of most promising advanced propulsion concepts; apply realistic computational models to optimize performance. Continue and refine experimental demonstrations of proof-of-concepts, continue development of realistic computational models. Continue system trade studies with improved performance models to evaluate potential return on investment.

(U) In FY 2009: Characterize, study, and evaluate shear injector performance to ensure chamber/injector compatibility and prevent damage to engines. Develop, analyze, and transition advanced combustion device technology, including injectors and chambers 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. Evaluate novel nozzle cooling channels for use with hydrocarbon fuels in the high heat flux test rig. Conduct validation and verification of advanced M&S capabilities. Perform pre-selection of most promising advanced propulsion concepts; apply realistic computational models to optimize performance. Continue and refine experimental demonstrations of proof-of-concepts, continue development of realistic computational models. Continue system trade studies with improved performance models to evaluate potential return on investment.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)					
(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.	0.000	5.513	5.932	6.713
(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)	In FY 2008: 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 components and optimize processing technology using multifunctional nanomaterials. Evaluate new class of hydrophobic and oleophobic materials.				
(U)	In FY 2009: 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 components and optimize processing technology using multifunctional nanomaterials. Continue to characterize and understand the mechanisms behind a new class of hydrophobic and oleophobic materials.				
(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	25.244	22.533	21.179
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Continued advance modeling and simulation tool development for advanced cryogenic liquid rocket upper stage technologies. Continue development of advanced cryogenic upper stage technologies - turbopumps and thrust chambers. Evaluate third set of potential hydrocarbon fuels and adjust/modify/ develop fuel characterization test rig. Complete development of second concept for				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602203F Aerospace Propulsion**	PROJECT NUMBER AND TITLE **33SP Space Rocket Component Tech**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	lightweight nozzles for liquid rocket engines. Start hydrocarbon boost technology development for future spacelift concepts including materials scale-up efforts to improve life and weight of the liquid engine components.				
(U)	In FY 2008: Complete advance modeling and simulation tool development for advanced cryogenic liquid rocket upper stage technologies. Continue enabling hydrocarbon boost technology development for future spacelift concepts. Initiate engine health monitoring effort supporting the hydrocarbon boost technology development effort. Also initiate Phase III efforts developing hydrocarbon engine technologies using fuels other than kerosene.				
(U)	In FY 2009: Continue enabling hydrocarbon boost technology development for future spacelift concepts. Develop engine health monitoring technologies supporting the hydrocarbon boost technology development effort. Develop advanced hydrocarbon engine technologies using fuels other than kerosene that address Phase III goals.				
(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	6.660	6.239	7.439
(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 scale-up testing Phase III monopropellants. Initiate assessment of advanced chemical propulsion technology developments for satellite thrusters. Initiate development of advanced multi-mode chemical-electric propulsion concepts for satellites.				
(U)	In FY 2008: Continue Hall thruster Phase III development efforts. Continue evaluating Phase III plasma thrusters for microsatellites propulsion systems. Continue scale-up testing Phase II and III monopropellants. Continue assessment of advanced chemical propulsion technology developments for satellite thrusters. Continue development of advanced multi-mode chemical-electric propulsion concepts for satellites. Initiate development of alternative propulsion concepts and associated modeling, simulation, and analysis tools to augment or replace Hall Thrusters in the future.				
(U)	In FY 2009: Continue Hall thruster Phase III development efforts. Continue evaluating Phase III plasma thrusters for microsatellites propulsion systems. Continue scale-up testing Phase II and III monopropellants, evaluate advanced ingnition schemes and chamber concepts. Continue assessment of				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	advanced chemical propulsion technology developments for satellite thrusters, begin component developments. Continue development of advanced multi-mode chemical-electric propulsion concepts for satellites, down-select to single design concept and begin component developments. Initiate development of alternative propulsion concepts and associated modeling, simulation, and analysis tools to augment or replace Hall Thrusters in the future.				
(U)					
(U)	MAJOR THRUST: Conduct assessments, 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. Note: In FY 2008, this effort will transfer within this PE to Project 623012, Advanced Propulsion Technologies, to consolidate and better manage this cooperative CCE effort.	0.000	0.239	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct 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 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Liquid Rocket Booster Technology.	0.000	1.395	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop hydrocarbon boost rocket engine technologies for the Air Force.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Vehicle and Propulsion Center.	0.000	3.188	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: 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 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602203F Aerospace Propulsion**	PROJECT NUMBER AND TITLE **33SP Space Rocket Component Tech**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)					
(U)	CONGRESSIONAL ADD: Engineering Tool Improvement Program (ETIP) Note: In FY 2006, this add was found in PE 0602500F, Multi-Disciplinary Space Technology, Project 5026, Rocket Propulsion Component Technology. In FY 2007, this add was titled Engineering Tool Improvement Program (ETIP) and transferred from PE 0602500F, Multi-Disciplinary Space Technology, Project 5026, Rocket Propulsion Component Technology to better manage development efforts.	0.000	2.789	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop advanced rocket engine modeling, simulation, and analysis tools for propulsion and integrating them into seamless suite of tools for scientists and engineers to use in developing advanced propulsion technologies.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Methane Second Stage Rocket Engine.	0.000	1.594	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop liquid oxygen, liquid methane pressure fed second stage rocket engine technologies for the Air Force.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	0.000	58.085	46.819	45.915

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Not Applicable.										

(U) D. Acquisition Strategy

Not Applicable

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602203F Aerospace Propulsion**	**4847 Rocket Propulsion Technology**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4847 Rocket Propulsion Technology	35.244	18.985	10.719	9.081	11.758	11.871	12.122	12.430	Continuing	TBD
Quantity of RDT&E Articles	0	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)/35 percent (Phase II) through the use of new materials, and improving designs and manufacturing techniques. Aging and surveillance efforts could reduce lifetime prediction uncertainties for individual motors by 50 percent, enabling motor replacement for cause (Phase II). 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 2006	FY 2007	FY 2008	FY 2009
(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. Note: Decreased funding in FY 2008 and out due to post boost control system component technology maturation and effort completions.	10.292	12.003	8.229	5.096

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

(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 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

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	solid propulsion. Conduct sub-scale tests to characterized and validate physics in rocket motor environments and incorporate into modeling and simulation tool developments for solid rocket motors to be used in developing components for the Phase II Missile Propulsion Demonstration.				
(U)	In FY 2008: Continue component development and risk reduction efforts for the Phase II Missile Propulsion demonstration. Conduct sub-scale testing 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 modeling, simulation, and analysis tool development efforts. Continue development of advanced tactical propulsion technologies.				
(U)	In FY 2009: Continue component development and risk reduction efforts for the Phase II Missile Propulsion demonstration. Complete verification 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. Down-select final sub-scale components, begin fabrication for sub-scale testing in FY 2010. Components will then be feed into upcoming Missile Propulsion Demo for scale-up and demonstration. Continue development of advanced tactical propulsion technologies.				
(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. Note: In FY 2007, this activity ramps up as it begins fabrication and testing of multiple demonstrator subsystems supporting future demonstrations across FY 2008 and beyond.	1.388	3.296	2.490	3.985
(U)	In FY 2006: Completed analysis of existing sensor technologies for use in assessment of ballistic missile aging characteristics and status. Identified and evaluated existing and advanced sensors that can be embedded or attached to solid rocket motors. Developed the aging and surveillance models and tools necessary to translate and integrate 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)	In FY 2008: 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	and surveillance models and tools that can translate and integrate the sensor data into existing aging and surveillance tool suite.				
(U)	In FY 2009: Complete 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. Begin efforts to integrate advanced aging and surveillance technologies into demonstrations to validate and verify efforts to reduce uncertainties and accurately model motor behavior.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Vehicle and Propulsion Center (AVPC).	4.170	0.000	0.000	0.000
(U)	In FY 2006: Performed technical support and analysis for the Prompt Global Strike Analysis of Alternatives (AoA). Conducted facility upgrades, which supported testing for planning efforts related to Land-based Strategic Deterrent and Operationally Responsive Spacelift activities.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Jet and Rocket Engine Test Site (JRETS) testing at San Bernardino International Airport.	17.454	0.000	0.000	0.000
(U)	In FY 2006: Upgraded 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: High Regression Rate Hybrid Rocket Fuels.	0.970	0.000	0.000	0.000
(U)	In FY 2006: Conducted 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	CONGRESSIONAL ADD: Aerospace Lab Equipment Upgrade.	0.970	0.996	0.000	0.000
(U)	In FY 2006: Obtained high speed and visualization tools for university educational and research purposes.				
(U)	In FY 2007: Upgrade/augment existing university facilities/capabilities to train future aerospace engineers.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Vortex Hybrid Propulsion System.	0.000	1.694	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop small launch vehicle size engines that utilize vortex combustion processes to generate improved performance and/or operability. Tasks include developments in propellant storage tanks as well as the engine designs. Engine concepts to be examined include LOx/Propane vortex cold-wall chamber as well as vortex hybrid designs.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Solid Boost Propulsion Technology for the Sustainment of Strategic Systems.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop technologies that aid in the sustainment of strategic solid rocket motors.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	35.244	18.985	10.719	9.081

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0601102F, Defense Research Sciences.										
(U)	PE 0602114N, Power Projection Applied Research.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

(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 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2007

BUDGET ACTIVITY: **02 Applied Research**

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

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	114.934	133.235	108.055	103.739	112.113	113.144	110.852	113.264	Continuing	TBD
2002	Electronic Component Technology	22.442	28.198	25.090	22.458	21.179	20.539	21.004	21.393	Continuing	TBD
2003	EO Sensors & Countermeasures Tech	22.141	22.111	16.077	16.346	16.400	16.567	16.914	17.299	Continuing	TBD
44SP	Space Sensors	0.000	8.848	10.244	8.948	10.556	10.477	10.541	10.775	Continuing	TBD
4916	Electromagnetic Tech	17.746	21.252	12.513	11.808	11.625	12.178	12.449	12.751	Continuing	TBD
6095	Sensor Fusion Technology	16.754	18.578	18.335	18.118	18.109	18.295	18.643	19.030	Continuing	TBD
7622	RF Sensors & Countermeasures Tech	35.851	34.248	25.796	26.061	34.244	35.088	31.301	32.016	Continuing	TBD

Note: In FY 2006, efforts in Project 5016 transferred to Project 2002 within this PE. Also in FY 2006, efforts in Project 5017 transferred 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 FY2007, Congress added $1.4 million for 3-D Packaging Technology for High Speed RF Communications; $1.0 million for Phased Array Antenna Control Computer; $1.6 million for the Center for Advanced Sensor and Communication Antennas; $1.7 million for the Super-Resolution Sensor System; $2.0 million for Compact, Ultra-sensitive Optical Receiver for Smart and Loitering Standoff Weapons; $1.1 million for Advanced Sensor Aided Vigilance Technologies; $2.0 million for Optically Pumped Atomic Laser; $1.0 million for Hanscom AFB Collaboration on Meta-Materials and Conformal Antenna Technologies; $2.0 million for WBI LADAR Development and Demonstration; $1.4 million for Wideband Digital Airborne Electronic Sensing Array; and $1.0 million for Sensor Network Technology. 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 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602204F Aerospace Sensors**

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

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	115.689	117.553	105.531	109.491
(U)	Current PBR/President's Budget	114.934	133.235	108.055	103.739
(U)	Total Adjustments	-0.755			
(U)	Congressional Program Reductions		-0.012		
	Congressional Rescissions	-0.006	-0.506		
	Congressional Increases		16.200		
	Reprogrammings	0.497			
	SBIR/STTR Transfer	-1.246			

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602204F Aerospace Sensors**	**2002 Electronic Component Technology**

Cost ($ in Millions)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2002	Electronic Component Technology	22.442	28.198	25.090	22.458	21.179	20.539	21.004	21.393	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2006, efforts in Project 5016 transferred 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 2006	FY 2007	FY 2008	FY 2009
(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.	5.408	8.466	6.962	7.566
(U) In FY 2006: Demonstrated low cost, lightweight subpanel for phased array radar applications. Demonstrated 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.				
(U) In FY 2008: Develop integrated wideband multi-channel phased array subarray with digital receiver/exciter architecture for future multi-intelligence EW/radar applications. Complete demonstration of distributed receiver/architecture for advanced multi-function systems used in radar and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	EW sensors.				
(U)	In FY 2009: Demonstrate integrated wideband subarray for future multi-intelligence EW/radar applications. Design and develop digital/receiver components to enable full digital receiver/exciter capability per transmit/receive (T/R) site to enable future software controlled phased arrays.				
(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.	1.119	4.214	3.758	3.418
(U)	In FY 2006: Developed engineering model of advanced photonic modulation components for low loss signal distribution.				
(U)	In FY 2007: Demonstrate integrated photonic microsystems. Develop electronics modeling and assessment techniques. Develop high performance radio frequency (RF) circuits on lightweight and flexible substrates using advanced semiconducting materials and devices.				
(U)	In FY 2008: Fabricate and perform lab testing to investigate physical and chemical properties of microcircuits under operating conditions to understand operating lifetime limiting changes in structure. Continue development of electronics modeling and assessment techniques. Develop flexible and transparent RF electronics.				
(U)	In FY 2009: Continue fabrication and lab testing to investigate physical and chemical properties of microelectronics to develop models to predict failure modes and lifetimes. Further refine electronics modeling and assessment techniques. Demonstrate flexible and RF transparent electronics.				
(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. Develop Electro-Optical (EO) devices for next generation warfighter applications.	2.824	4.367	6.224	3.266
(U)	In FY 2006: Designed and fabricated advanced components for external and direct modulation of optical sources with high efficiency for RF photonic links used in radar and communications. Demonstrated optical modulation technology with high linearity and dynamic range for ISR, battlespace access, and time-sensitive targeting capabilities.				
(U)	In FY 2007: Design and develop RF modulation components to enable low loss wideband RF links and arbitrary EO waveform generation. Initiate development of veritcal, external cavity, surface emitting lasers (VECSEL) as compact, efficient, high-nrightness sources. Initiate development of fiber optics and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	optical components for high power mid-infrared (IR) applications.				
(U)	In FY 2008: Demonstrate photonic RF modulation components for RF links and arbitrary EO waveform generation. Continue development of VECSELs as compact, efficient, high-brightness sources. Continue development of fiber optics and optical components for high power mid-IR applications.				
(U)	In FY 2009: Further develop VECSELs as compact, efficient, high-brightness sources. Complete development of fiber optics and optical components for high power mid-IR applications.				
(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.	6.463	5.262	5.924	5.968
(U)	In FY 2006: Designed, implemented, and characterized low insertion loss tunable filters for advanced RF multifunction front ends. Demonstrated RF transistors with five-fold reduction in parasitic capacitance for equivalent power output. Designed and demonstrated Gallium Nitride (GaN) based field-effect devices with enhanced power handling 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. Complete characterization of high reliability GaN based circuits for millimeter wave and Q-band applications.				
(U)	In FY 2008: Develop and demonstrate adaptable microcircuits for multi-function sensors.				
(U)	In FY 2009: Develop tunable and reconfigurable wideband amplifiers for use in multi-function radar and EW sensors.				
(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.	0.968	2.207	1.119	1.122
(U)	In FY 2006: Developed advanced component characterization techniques to assess and mitigate failures in emerging semiconductor technologies and to develop predictive failure models.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2007: Design and implement military specific RF components using advanced circuit design techniques and latest commercial foundry advances. Characterize and perform trade-space analysis with respect to traditional RF component technologies.				
(U)	In FY 2008: Investigate microcircuit integration modeling and simulation tools to enable two-dimensional and three-dimensional electronics.				
(U)	In FY 2009: Develop and demonstrate highly integrated phase control components for use in wideband multi-function sensors.				
(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.	3.710	2.287	1.103	1.118
(U)	In FY 2006: Modeled and transitioned 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)	In FY 2008: Continue design and refinement of models for next generation high-power components that operate under extreme conditions and enable multi-function sensors.				
(U)	In FY 2009: Demonstrate models and designs through the characterization of high-power components for use in extreme environments with wideband and multi-function capability.				
(U)					
(U)	CONGRESSIONAL ADD: 3-D Packaging Technology for High Speed RF Communications.	1.950	1.395	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for 3-D Packaging Technology for High Speed RF Communications.				
(U)	In FY 2007: Conduct Congressionally-directed effort for 3-D Packaging Technology for High Speed RF Communications.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	22.442	28.198	25.090	22.458

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602204F Aerospace Sensors**	PROJECT NUMBER AND TITLE **2002 Electronic Component Technology**

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2003	EO Sensors & Countermeasures Tech	22.141	22.111	16.077	16.346	16.400	16.567	16.914	17.299	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop technology for non-cooperative detection and identification of airborne and ground-based targets.	1.862	2.795	2.858	2.978

(U) In FY 2006: Expanded ground- and air-based testing and demonstration of advanced combat identification (CID) systems with multi-spectral, polarization-based detection and cueing and active EO combat identification sensors to include 3-D imaging. Developed hybrid focal planes and read-out electronics capable of simultaneous multi-discriminant sensing. Completed 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) In FY 2008: Perform phenomenology experiments for multi-discriminant active/passive sensing and perform sensor concept modeling. Collect signature data for target discrimination and shape extraction using passive multispectral/polarimetric sensing techniques. Characterize the performance of a longwave hyperspectral sensor for performing identification of gaseous targets. Demonstrate hybrid focal planes and read-out electronics for simultaneous multi-discriminant active/passive sensing, and develop image processing techniques for sensor data enhancement.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602204F Aerospace Sensors**	PROJECT NUMBER AND TITLE **2003 EO Sensors & Countermeasures Tech**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Perform sensor concept demonstrations for multi-discriminant active/passive sensing and quantify expected system performance. Characterize target discrimination and shape extraction performance using passive multispectral/polarimetric sensing techniques. Continue demonstration of hybrid focal planes and read-out electronics for simultaneous multi-discriminant active/passive sensing, and refine image processing techniques for sensor data enhancement. Perform trade-off studies for long range target identification using passive and active techniques, including polarimetric discrimination and synthetic aperture laser radar.				
(U)					
(U)	MAJOR THRUST: Develop optical transmitter technology capable of sensing multiple target characteristics for robust non-cooperative target identification.	3.051	7.384	5.973	6.561
(U)	In FY 2006: Tested optical transmitter technologies capable of sensing multiple target characteristics for robust non-cooperative target identification. Developed adaptable waveforms for multi-discriminant sensing. Conducted laboratory and field tests and utility analysis of multi-function pulsed vibration/imaging sensing system and evaluated performance for long range CID. Performed initial flights for pulsed gated imager and vibration CID sensor. Tested breadboard active multi-spectral transmitter and evaluated performance for both hard and extended targets. Conducted flight capable, long-range, multi-function brassboard sensor development. Utilized flight test platform to support testing of long-range air-to-air and air-to-ground systems under development. Collected 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)	In FY 2008: Extend development and testing of optical transmitter technologies for non-cooperative				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	target identification to increased standoff ranges. Explore optical discriminants for long range identification including shape, polarization, and vibration using real-beam and synthetic aperture sensing techniques. Develop advanced models to support phenomenology-driven sensor trade studies with both active and passive sensors. Perform tower and flight collections to validate system modeling results. Explore enabling sensor components to support extended range operation.				
(U)	In FY 2009: Continue development and testing of optical transmitter technologies for non-cooperative target identification at long standoff ranges. Perform multi-function signature collections for long range identification including shape, polarization, and vibration using real-beam and synthetic aperture sensing techniques. Develop optimal system concepts using advanced active and passive sensor models. Continue tower and flight collections to quantify expected performance. Develop enabling sensor components for a long range demonstration system.				
(U)					
(U)	MAJOR THRUST: Develop innovative techniques and components to target difficult objects in battlefield environments.	4.782	3.561	3.660	3.807
(U)	In FY 2006: Developed techniques and components to target difficult objects in degraded atmospheric conditions. Integrated and evaluated weather/obscurant penetration concepts. Evaluated utility of non-mechanical beam steering concepts for advanced multi-mode sensor applications including precision pointing, focusing, and wavefront correction and extended to common EO/radio frequency (RF) aperture implementation. Developed and demonstrated combined EO/RF aperture including preliminary sensor configuration. Continued tests, analysis, and evaluation of specialized multi-function laser radar (LADAR) for detection and characterization of difficult targets. Completed optimized architecture definition for advanced EO unmanned aerial vehicle (UAV) based systems to find, fix, and identify difficult targets in difficult environments including the urban environment. Incorporated advanced passive and multi-function active sensing methods to exploit all salient target and background phenomenologies. Performed 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				

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	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)	In FY 2008: Extend development of techniques for targeting difficult objects in dynamic urban environments. Develop passive infrared components and techniques for continuous surveillance of broad areas with detection/tracking of dynamic targets and events. Continue development of non-mechanical beamsteering for both passive and active sensors. Explore passive and active LADAR sensing phenomenology techniques for capturing robust spectral, spatial, polarimetric, and radiometric signatures for moving target identification and track association in dense target areas.				
(U)	In FY 2009: Continue development of techniques for targeting difficult objects in dynamic urban environments. Perform concept demonstrations of passive infrared continuous surveillance of broad areas with detection/tracking of dynamic targets and events. Develop sensor concept designs for optimizing revisit rate and perform design trade-off experiments. Perform spectral, spatial, polarimetric, and radiometric signature collection experiments using laboratory passive and active LADAR sensors for moving target identification and track association in dense target areas.				
(U)					
(U)	MAJOR THRUST: Develop countermeasure technologies for use against IR- and EO-guided missile threats.	2.442	1.995	2.919	2.246
(U)	In FY 2006: Evaluated countermeasure techniques to defeat first generation IR imaging missile seekers. Conducted the exploitation of advanced IR missiles and IR sensor technology for countermeasure technique updates and refinement. Developed active sensing technology to defeat multi-band IR sensors.				
(U)	In FY 2007: Complete 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)	In FY 2008: Continue development of second generation IR imaging missile seeker models/simulations				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	for countermeasure technique development. Continue exploitation of advanced IR missiles and IR acquisition sensors for countermeasure technique updates and refinement. Initiate identification of discriminants for specific identification of new EO sensors and missile threats.				
(U)	In FY 2009: Evaluate countermeasures techniques to defeat second generation IR imaging missile seekers. Develop new countermeasure technique updates and refinement applicable to legacy systems. Continue identification of discriminants for specific identification of new EO sensors and missile threats.				
(U)					
(U)	MAJOR THRUST: Develop aerospace missile and laser warning technologies to accurately cue countermeasures.	1.715	0.698	0.667	0.754
(U)	In FY 2006: Completed developing a laser threat scenario testbed for sensor technology evaluations. Developed new laser warning sensor technologies to address ultra-short and tunable laser threats. Developed advanced laser warning concepts for aircraft, to include integration into UAVs and night vision goggles (NVG).				
(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)	In FY 2008: Continue developing new laser warning sensor technologies to address ultra-short and tunable laser threats. Identify methods to increase focal plane array dynamic range for precise characterization of low power and high power laser threats.				
(U)	In FY 2009: Continue developing new laser warning sensor technologies to address ultra-short and tunable laser threats. Identify clutter suppression techniques to increase signal to noise and improve detection ranges in urban operations. Evaluate algorithms to optimize detection/declaration ranges.				
(U)					
(U)	CONGRESSIONAL ADD: Watchkeeper.	4.096	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Watchkeeper.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Super-Resolution Sensor System.	3.218	1.694	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for the Super-Resolution Sensor System.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602204F Aerospace Sensors**	PROJECT NUMBER AND TITLE **2003 EO Sensors & Countermeasures Tech**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2007: Conduct Congressionally-directed effort for the Super-Resolution Sensor System.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSSIONAL ADD: Optically Pumped Atomic Laser (OPAL).	0.975	1.992	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for OPAL.				
(U)	In FY 2007: Conduct Congressionally-directed effort for OPAL.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: WBI LADAR Development and Demonstration	0.000	1.992	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for WBI LADAR Development and Demonstration.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	22.141	22.111	16.077	16.346

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602204F Aerospace Sensors**	PROJECT NUMBER AND TITLE **2003 EO Sensors & Countermeasures Tech**

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

harmonize efforts and
eliminate duplication.

(U) **D. Acquisition Strategy**

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 44SP Space Sensors

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
44SP Space Sensors	0.000	8.848	10.244	8.948	10.556	10.477	10.541	10.775	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop hybrid space-based sensor solutions and reduce associated technology risks. Investigate hardware and software implementation approaches for the needs of responsive space and of difficult targets from space. Develop space-qualified precision time, position, and velocity sensors capable of operating in jamming environments while enabling multiple platform sensor-to-warfighter operations. 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	3.970	3.161	4.092

(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) In FY 2008: Define responsive space sensor functional capabilities and implementation assessments. Model size, weight, and power (SWaP)-restricted 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 2009: Experimentally assess feasibility of responsive "plug- n- play" satellite implementation concept. Design SWaP-restricted precision time, position, and velocity sensor techniques for space-based applications. Demonstrate constructive systems engineering model to assess space-based assured reference techniques in terms of measures of performance and warfighter utility.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 44SP Space Sensors

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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. Develop multi-band and multi-beamforming technologies. Address technologies for antenna array operations in dynamic sensor networks. Supports ISR capability.	0.000	2.215	3.199	0.954
(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)	In FY 2008: Develop sub-array level digital beamforming and low-cost L-band antenna panels.				
(U)	In FY 2009: Experimentally assess enhanced antenna signal interference compatibility capability.				
(U)					
(U)	MAJOR THRUST: Study adaptive processing techniques for large, multi-mission, space-based conformal arrays to meet the stringent demands of wide area coverage, target detection, and target tracking in severe clutter and interference environments.	0.000	1.733	1.819	1.859
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop 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)	In FY 2008: Evaluate adaptive transmit and receive techniques for surface moving target indication (SMTI) from space under a variety of tactical scenarios and interference environments.				
(U)	In FY 2009: Integrate developed algorithms, waveforms and space platform scenarios into a surveillance network of sensors.				
(U)					
(U)	MAJOR THRUST: Develop advanced component technology for space-based sensors that focuses on improving performance and reducing size, mass, and prime power. Investigate pre-space qualification issues associated with newer component technologies to ensure more rapid and accurate transitions. Supports ISR capability.	0.000	0.930	0.752	0.679
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop and model an initial reduced power architecture for large area antennas.				
(U)	In FY 2008: Validate new low-cost RF sub-assembly technology compatibility for space qualification. Evaluate plastic packaging, liquid crystal polymer packages, and RF-on-Flex boards.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602204F Aerospace Sensors**	PROJECT NUMBER AND TITLE **44SP Space Sensors**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Develop compact tunable filters for interference signal rejection in dense signal environments.				
(U)					
(U)	MAJOR THRUST: Develop sensor technologies to achieve highly accurate and robust navigation performance for hypersonic air vehicles in prompt global strike applications. Note: This work is an outgrowth of other efforts within this Project.	0.000	0.000	1.313	1.364
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Model hypersonic air vehicle plasma characteristics, platform trajectories, and highly accurate and robust navigation techniques for space-based applications. Develop constructive systems engineering model to assess hypersonic navigation techniques in terms of measures of performance and warfighter utility.				
(U)	In FY 2009: Design RF hardware-in-the-loop testbed to implement hypersonic air vehicle plasma characteristics, platform trajectories, and highly accurate and robust navigation techniques for space-based applications. Demonstrate constructive systems engineering model to assess hypersonic navigation techniques in terms of measures of performance and warfighter utility.				
(U)	Total Cost	0.000	8.848	10.244	8.948

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602204F Aerospace Sensors**	PROJECT NUMBER AND TITLE **44SP Space Sensors**

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

harmonize efforts and
eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602204F Aerospace Sensors**	**4916 Electromagnetic Tech**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4916 Electromagnetic Tech	17.746	21.252	12.513	11.808	11.625	12.178	12.449	12.751	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Investigate detection of difficult airborne and ground-based targets in clutter from airborne or space-based surveillance platforms.	2.923	3.563	3.128	3.234
(U) In FY 2006: Developed 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) In FY 2008: Develop techniques for fully adaptive sensing and processing combining EM phenomenology, cognitive algorithms and signal processing pertaining to waveform diverse sensing and distributed sensing.				
(U) In FY 2009: Develop analytical and computationally efficient tools for multi-sensor integration for target detection, tracking and classification in a knowledge-aided framework exploiting physics based and data dependent EM models of targets and clutter.				
(U)				
(U) MAJOR THRUST: Design and develop antennas for airborne and space-based surveillance.	3.111	3.774	3.331	3.444
(U) In FY 2006: Developed and demonstrated novel RF and digital hardware architectures and embedded algorithms that achieve wideband digital beamforming for multi-function phased arrays. Analyzed and developed advanced 3-D micro-electro-mechanical systems (MEMS) RF structures that improve RF circuit design flexibility and reduce the size and cost of microwave integrated circuits. Investigated and developed 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	microwave integrated circuits into low-cost 3-D MEMS RF structures designed for a miniature seeker radar. Analyze and develop digital beamforming architectures for conformal phased array antennas for future air-to-air radar system applications.				
(U)	In FY 2008: Integrate optimal algorithms with mixed circuit RF wide-band beamforming hardware to demonstrate lower cost lightweight sensor platforms. Demonstrate low-cost miniature seeker hardware. Transition newly developed digital beamforming architectures to new airborne radar platforms.				
(U)	In FY 2009: Develop new low-cost digital beamforming techniques for miniature unmanned aerial vehicle (UAV). Integrate new detection algorithm with low cost seeker hardware. Integrate and test new conformal digital beamforming phased array antennas on airborne radar platforms.				
(U)					
(U)	MAJOR THRUST: Design and develop new EO techniques and components for detecting and identifying concealed targets.	2.545	3.281	2.724	2.816
(U)	In FY 2006: Tested newly developed avalanche photo diodes (APD) integrated with electronic readout circuits. Integrated subcomponents with flash laser radar (LADAR) system and performed live tests to evaluate guidance and range resolution capability. Tested and evaluated next generation APD designs and incorporated in 3-D LADAR test-bed. Developed 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)	In FY 2008: Develop new Focal Plane Array (FPA) materials and APD device technologies to enhance autonomous munitions, staring FPAs, target identification and tracking applications. Develop 2-D pixel-based electronic control circuits for enhanced imaging. Integrate these FPAs with the electronic control circuits for a compact 3-D FPA capability.				
(U)	In FY 2009: Develop new quasi-phase matched materials such as Gallium Phosphate (GaP) and techniques for efficient optical sources in the mid- and long- wave IR applications. Develop new material systems to enable conversion from pump wavelengths between one and two microns. Continue testing of integrated FPA.				
(U)					

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Develop hardware and software for passive multi-dimensional sensing in the thermal infrared spectral wavelength range at high frame rates.	3.110	3.661	3.330	2.314
(U)	In FY 2006: Designed dual band tomographically based sensor system utilizing Cross Dispersion Prism (CDP) to characterize energetic battlefield events in real-time. Created CDP prototype and began in-house calibration and performance evaluation. Refined CDP techniques used to validate target declaration and reduce false alarms. Designed and developed 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 and battle damage assessment.				
(U)	In FY 2008: Perform critical technical assessments via field testing on hyperspectral EO sensors developed in prior years. Evaluate the potential of sensing rapidly changing EO spectra from hot battlefield events (rocket propelled grenades, mortars, man-portable air defense systems, muzzle flash). Use results of collections to define small portable systems that can be fielded to provide rapid tactical information to commanders about the location and type of weapons being fired at friendly forces. Perform initial testing on a new hyperspectral approach to finding and identifying toxic gas clouds.				
(U)	In FY 2009: Develop new EO sensor hardware for detecting chemical, biological, radiological, and nuclear weapons using spectral/hyperspectral intelligence. Perform initial testing to assess sensor detection and identification, viability, and initiate plan for transition. Continue development of hyperspectral and multispectral sensors and create a small, deployable instrument suitable for moving into transition with an advanced technology demonstrator. Initiate utility assessment of hyperspectral sensors for collecting data at millisecond sample rates for space based applications.				
(U)					
(U)	CONGRESSIONAL ADD: Optical Maximum Entropy Verification (OMEV).	0.976	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Optical Maximum Entropy Verification.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Stable Articulating Backbone for Ultralight Radar (SABUR).	0.975	0.000	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602204F Aerospace Sensors**	PROJECT NUMBER AND TITLE **4916 Electromagnetic Tech**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2006: Conducted Congressionally-directed effort for SABUR.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Center for Advanced Sensor and Communication Antennas.	1.169	1.594	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for the Center for Advanced Sensor and Communication Antennas.				
(U)	In FY 2007: Conduct Congressionally-directed effort for the Center for Advanced Sensor and Communication Antennas.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Phased Array Antenna Control Computer.	0.975	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for the Phased Array Antenna Control Computer.				
(U)	In FY 2007: Conduct Congressionally-directed effort for the Phased Array Antenna Control Computer.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Compact Ultra-sensitive Optical Receiver for Smart and Loitering Standoff Weapons.	0.976	1.992	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for a Compact Ultra-sensitive Optical Receiver for Smart and Loitering Standoff Weapons.				
(U)	In FY 2007: Conduct Congressionally-directed effort for a Compact Ultra-sensitive Optical Receiver for Smart and Loitering Standoff Weapons.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Hanscom AFB Collaboration on Meta-Materials and Conformal Antenna Technologies.	0.986	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Hanscom AFB Collaboration on				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Meta-Materials and Conformal Antenna Technologies.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Hanscom AFB Collaboration on Meta-Materials and Conformal Antenna Technologies.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Wideband Digital Airborne Electronic Sensing Array.	0.000	1.395	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionall-directed efforts for Wideband Digital Airborne Electronic Sensing Array.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	17.746	21.252	12.513	11.808

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2007**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602204F Aerospace Sensors**	**6095 Sensor Fusion Technology**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
6095 Sensor Fusion Technology	16.754	18.578	18.335	18.118	18.109	18.295	18.643	19.030	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop and assess single and multi-sensor ATR and sensor fusion algorithms for rapidly finding, tracking, and targeting mobile targets.	2.720	2.214	2.182	2.362
(U) In FY 2006: Developed improvement in image formation and processing of synthetic aperture radar (SAR) data from research and development (R&D) data collections. Completed automated image analysis and truthing tools. Developed synthetic data generation tools to augment and enhance collected R&D and operational data sets. Completed initial ATR R&D computer and networking infrastructure via software, hardware, and network integration enhancements. Completed assessing the effectiveness of real-time ATR algorithms for time-critical targets on embedded high-performance computing systems. Conducted laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Conducted ATR performance evaluation theory research for radar, electro-optical (EO), and multiple sensor ATR technologies. Laboratory tested the first multi-sensor ATR performance prediction model. Assessed methods and measures for moving target tracking and identification (ID) approaches using multiple sensor types. Developed 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 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				

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	and rapid response systems proposed for post-conflict force protection, stability, and security operations.				
(U)	In FY 2008: Develop improved image formation and processing of SAR data from R&D data collections to enhance those features that most impact ATR detection and classification performance. Continue to develop image and data formation and processing of EO, infrared (IR), and hyperspectral imaging (HSI) data from R&D data collections. Continue development of multi-sensor/multi-frequency synthetic data generation tools to augment and enhance collected R&D and operational data sets. Continue laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Enhance ATR performance evaluation techniques for radar ATR technology and continue for EO and multiple sensor ATR technologies. 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)	In FY 2009: Assess the image formation and processing of SAR, EO/IR/HSI data from R&D data collections taking advantage of disparate phenomenology to improve ATR detection, classification and identification performance. Develop and validate multi-sensor/multi-frequency synthetic data generation tools required to augment and enhance collected R&D and operational data sets. Initiate development of tools and technology supporting other phenomenological features that heretofore have not been exploited. Continue laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Enhance ATR performance evaluation techniques for radar ATR technology and continue for EO and multiple sensor ATR technologies. Continue assessment methods and measures for moving target tracking and ID approaches using multiple sensor types. Demonstrate initial 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.	5.263	3.116	5.635	5.887
(U)	In FY 2006: Matured target signature models for signature exploitation of radio frequency (RF) sensors, EO multi-spectral systems, and signals intelligence (SIGINT) sensors. Developed signatures, algorithms, and modeling support for RF and multiple EO phenomenology ATR of tactical ground targets. Generated synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Developed a synthetic scene data				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

generation capability for RF scenes applicable to large area reconnaissance coverage. Conducted investigation of model-driven spectral signal processing and exploitation techniques. Developed 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 modes of operation for existing sensors, and signal processing/exploitation for high diversity data.

(U) In FY 2008: Develop and validate target signature models for signature exploitation of RF sensors, EO multi-spectral systems, and SIGINT sensors. Develop signatures, algorithms, and modeling technologies and their supporting tools for analysis and evaluation for multiple RF and EO phenomenology ATR of tactical ground targets; introduce civilian vehicles. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Complete demonstration of a synthetic scene data generation capability for RF scenes and continue development of an EO scene capability applicable to large area reconnaissance coverage. Continue investigation of model-driven spectral signal processing and exploitation techniques. Measure performance of initial ATR algorithm-driven RF sensor design, including new modes of operation for existing sensors, and signal processing/exploitation for high diversity data.

(U) In FY 2009: 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 and civilian vehicles. Initiate the development of signatures, algorithms, target modeling and phenomenological modeling of other phenomenological features that heretofore have not been exploited. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Continue development of an EO scene capability applicable to large area reconnaissance coverage. Continue investigation of model-driven spectral signal

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	processing and exploitation techniques. Continue development of ATR algorithm-driven RF sensor design, new 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.	7.796	12.152	9.021	8.367
(U)	In FY 2006: Conducted fusion of exploitable radar, EO/infrared (IR), laser radar (LADAR), and hyperspectral features for target detection, tracking, and ID with sensor management techniques. Evaluated physics-based techniques for target detection and identification for ISR and CID applications. Transitioned 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. 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. Conducted research of bio-inspired ATR for robustness. Researched ATR, sensor management, and sensor fusion 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)	In FY 2008: Develop and validate a fusion capability that exploits radar, EO/IR, LADAR, and hyperspectral features for target detection, tracking, and ID with sensor management techniques. Evaluate physics-based techniques for target detection and identification for ISR and CID applications to determine technology shortfalls. Initiate development of automated battle space behavior analysis. Continue development and initiate assessment of technology that will capitalize on precision time,				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Continue development of multi-sensor 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. Extend ATR, sensor management, and sensor fusion research for urban ISR from small UAVs to include civilian objects of interest.				
(U)	In FY 2009: Complete initial fusion capability for radar, EO/IR, LADAR, and hyperspectral features for target detection, tracking, and ID with sensor management techniques. Evaluate and improve physics-based techniques for target detection and identification for ISR and CID applications. Continue development and initiate evaluation of automated battle space behavior analysis. 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; initiate its incorporation into fusion functions. Complete and evaluate initial multi-sensor, 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 and initiate evaluation of these techniques for urban applications. Evaluate ATR, sensor management, and sensor fusion research for difficult urban ISR from small UAVs for civilian objects of interest.				
(U)					
(U)	MAJOR THRUST: Develop fundamental technical methods required for algorithm performance models, ATR driven sensing, layered sensing and other sensing and exploitation technologies impacted by ATR capabilities. Note: This work is an outgrowth of other work within this project.	0.000	0.000	1.497	1.502
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Assess the state of the art in ATR predictive methods. Determine exploitation and sensing technologies that require the integration of ATR techniques. Develop fundamental ATR approaches for various subcomponents.				
(U)	In FY 2009: Evaluate new innovations in ATR related technologies. Continue development of fundamental ATR approaches for subcomponents. Begin development of integrated, unified ATR methodology building upon the various ATR subcomponent efforts.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Sensor Aided Vigilance Technologies.	0.975	1.096	0.000	0.000

Exhibit R-2a, RDT&E Project Justification

DATE	
February 2007	

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602204F Aerospace Sensors**	**6095 Sensor Fusion Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2006: Conducted Congressionally-directed effort for Advanced Sensor Aided Vigilance Technologies.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Advanced Sensor Aided Vigilance Technologies.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	16.754	18.578	18.335	18.118

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602204F Aerospace Sensors**	PROJECT NUMBER AND TITLE **6095 Sensor Fusion Technology**

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	0602204F Aerospace Sensors	7622 RF Sensors & Countermeasures Tech

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
7622	RF Sensors & Countermeasures Tech	35.851	34.248	25.796	26.061	34.244	35.088	31.301	32.016	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2006 efforts in Project 5017 transferred 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 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 2006	FY 2007	FY 2008	FY 2009
(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.	1.684	0.000	0.000	0.000
(U)	In FY 2006: Completed development and test of a complex signal communication environment simulator that contains both adversary and friendly advanced spread spectrum signals. Completed development and test of technology for an advanced digital communications jammer. Completed exploitation evaluations against new, advanced RF threats. Performed exploratory research into development of networked electronic attack techniques.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: 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	5.099	18.196	12.759	15.887

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

and techniques to provide 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. Note: There is increased emphasis on this effort beginning in FY 2007.

(U) In FY 2006: Identified and analyzed advanced receiver/exciter techniques for operation with temporally and spatially adaptive electronic support (ES) and radar antenna systems. Identified and analyzed advanced digital signal processing techniques that support distributed and adaptive ES and radar receiver/exciter sensor systems. Minimized SWaP for advanced apertures and receivers, waveform diversity, assured reference, and machine-to-machine sensor cross cueing. Investigated innovative techniques to provide concurrent RF radar and electronic warfare (EW) with electro-optical (EO) compatibility on a single platform. Developed 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) In FY 2008: Develop and evaluate advanced mode control concepts to provide concurrent multi-function RF radar and electronic warfare (EW) compatibility on a single platform. Develop integrated RF (radar and EW) and EO modeling, simulation, and analysis capabilities to address broader system-level multi-intelligence trades. Develop advanced digital receiver techniques for adaptive ES for passive multi-mode platform operations. Continue development and evaluation of advanced digital receiver/exciter technologies for ES and radar applications that support multiple degrees-of-freedom adaptivity. Continue development and evaluation of advanced digital receiver signal processing concepts/techniques for adaptive operation in complex signal environments. Perform digital receiver simulation, modeling and analysis for ES scenarios in modern signal environments. Refine reductions in size, weight, and power in RF sensors compatible with severely constrained unmanned air platforms.

(U) In FY 2009: Continue system-level multi-intelligence trades through integrated RF (radar and EW) and

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	EO modeling, simulation, and analysis. Continue to develop and evaluate advanced mode control concepts to provide concurrent RF radar and EW with EO compatibility on a single platform. Define approaches allowing the simultaneous design and development of sensors and their back-end exploitation functions. Develop advanced ES digital receiver concepts/techniques for spatial and temporal adaptivity to overcome limitations to precision emitter parameterization in complex environments. Continue development and evaluation of advanced adaptive digital receiver/exciter technologies for ES, radar and passive multi-mode applications. Continue digital receiver simulation, modeling and analysis for ES scenarios in modern signal environments. Continue to refine reductions in size, weight, and power in RF sensors compatible with severely constrained unmanned air platforms.				
(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. Assess next generation applied RF aperture technology.	6.077	4.362	1.004	0.883
(U)	In FY 2006: Designed and modeled thin profile, wideband arrays for ES receive applications. Designed and fabricated array beam steering capability for wideband array jammer transmitter. Designed and modeled compact, wideband direction finding antenna. Extended 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. Evaluate performance of directional wideband array transmitter. Complete fabrication and test of compact, wideband direction finding antenna for close in sensing.				
(U)	In FY 2008: Integrate compact digital receiver/exciter to thin-profile array.				
(U)	In FY 2009: Lab demonstrate and test thin profile array with integrated receiver/exciter.				
(U)					
(U)	MAJOR THRUST: Develop multi-function RF sensing concepts and RF transformational element level arrays for concurrent multi-mode operation.	2.103	2.822	3.109	1.807
(U)	In FY 2006: Fabricated and laboratory tested low-cost millimeter wave sensor that provides height indication in addition to azimuth and range for landing in obscured environments. Designed 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). Extended array simulations to determine technology shortfalls for full element level digital beam forming (DBF).				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)					
(U)	In FY 2007: Design autonomous constellation of active and passive air, space, and ground sensor techniques for close-in sensing applications using distant sources of opportunity. 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)	In FY 2008: Develop autonomous constellation of active and passive air, space, and ground sensor techniques for close-in sensing applications using distant sources of opportunity. Design and develop panel technology for multi-mode array to demonstrate concurrent operation.				
(U)	In FY 2009: Lab demonstrate autonomous constellation of active and passive air, space, and ground sensor techniques for close-in sensing applications using distant sources of opportunity. Demonstrate and test multi-mode array with element level DBF.				
(U)					
(U)	MAJOR THRUST: Develop digital RF receiver/exciter technology to support DBF.	6.027	3.669	3.739	1.522
(U)	In FY 2006: Developed and modeled DBF-specific receiver/exciter technologies that stress reduced size, weight, and power consumption, as well as increased affordability for ES and radar sensor systems. Demonstrated 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 power consumption receiver/exciter technologies that support multi-function RF sensor concepts.				
(U)	In FY 2008: Develop subsystem engineering, simulation, and characterization technologies for integrated wideband RF aperture, wideband receiver/exciter, and DBF signal processing.				
(U)	In FY 2009: Lab demonstrate advanced wideband RF aperture and wideband receiver/exciter with DBF signal processing subsystem to validate subsystem engineering, simulation, and characterization technologies.				
(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. Note: Effort completes in FY 2006.	0.911	0.000	0.000	0.000
(U)	In FY 2006: Demonstrated critical experiments in innovative time transfer techniques for network centric warfare applications. Developed engineering tools to implement advanced electronic				

(U)	**B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
	counter-countermeasure (ECCM) techniques. Validated the engineering tools using both synthetic and field collected data.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: 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 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.	6.733	4.203	5.185	5.962
(U)	In FY 2006: Evaluated 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. Optimized waveforms for multi-sensor, multi-mode operations for moving target indicator (MTI) surveillance platforms. Developed advanced radar signal processing algorithms for multi-sensor, multi-mode operation. Completed initial development of wideband and polarization adaptive processing techniques for multi-function radar. Evaluated adaptive processing techniques for multi-mission conformal arrays. Completed initial development of 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)	In FY 2008: Evaluate distributed processing technology for next generation deep-reach target detection and tracking. Utilize high fidelity simulation tools. Plan for future experiments.				
(U)	In FY 2009: Initiate and conduct experiments to demonstrate the advantages and performance improvements of adaptive transmit waveforms, new distributed sensor receive processing techniques, and distributed sensing.				
(U)					

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	CONGRESSIONAL ADD: Minority LEADERS Research Program.	1.756	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for the Minority LEADERS Research Program.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Small Disadvantaged Business, Historically Black Colleges and Universities.	5.461	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Small Disadvantaged Business, Historically Black Colleges and Universities.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Sensor Network Technology.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Sensor Network Technology.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	35.851	34.248	25.796	26.061

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

(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 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

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Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
02 Applied Research

PE NUMBER AND TITLE
0602500F MULTI-DISCIPLINARY SPACE TECH

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	89.761	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5023	Laser & Imaging Space Tech	7.701	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5025	Space Materials Development	19.197	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5026	Rocket Propulsion Component Tech	48.113	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5027	High Speed Airbreathing Prop Tech	0.239	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5028	Space Sensors, Photonics & RF Proc	1.848	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5029	Space Sensor & CM Tech	1.074	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5082	Optical Networking Tech	11.589	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2007, Project 625023, Laser and Imaging Space Technology, efforts transfer to PE 0602605F, Directed Energy Technology, Project 6255SP, Laser and Imaging Space Technology; Project 625025, Space Materials Development, efforts transfer to PE 0602102F, Materials, Project 6210SP, Space Materials Development; Project 625026, Rocket Propulsion Component Technology, and Project 625027, High Speed Airbreathing Propulsion Technology, efforts transfer to PE 0602203F, Aerospace Propulsion, Project 6233SP, Space Rocket Component Technology; Project 625028, Space Sensors, Photonics and Radio Frequency (RF) Processes, and Project 625029, Space Sensor and Countermeasure (CM) Technology, efforts transfer to PE 0602204F, Aerospace Sensors, Project 626244 SP, Space Sensors; Project 625030, Applied Space Access Vehicle Technology, efforts transfer to PE 0602201F, Aerospace Vehicle Technologies, Project 6222SP, Applied Space Access Vehicle Technology; and Project 625082, 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. Funds for the FY 2007 Congressionally-directed Engineering Tool Improvement Program (ETIP) in the amount of $2.8 million were moved to PE 0602203F, Aerospace Propulsion, Project 6233SP, Space Rocket Component Technology, and the funds for the Congressional-directed Integrated Control for Autonomous Space Systems were moved to PE 0602601F, Space Technology, Project 628809, Spacecraft Vehicle Technologies, from this PE for execution.

(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 2007, Congress added $2.8 million for Engineering Tool Improvement Program (ETIP) and $1.6 million for Integrated Control For Autonomous Space 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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	91.694	0.000	0.000	0.000
(U)	Current PBR/President's Budget	89.761	0.000	0.000	0.000
(U)	Total Adjustments	-1.933			
(U)	Congressional Program Reductions				
	Congressional Rescissions	-0.005			
	Congressional Increases		4.400		
	Reprogrammings	-0.383	-4.400		
	SBIR/STTR Transfer	-1.545			

(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 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602500F MULTI-DISCIPLINARY SPACE TECH**	**5023 Laser & Imaging Space Tech**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5023 Laser & Imaging Space Tech	7.701	0.000	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	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 2006	FY 2007	FY 2008	FY 2009
(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.	5.796	0.000	0.000	0.000
(U) In FY 2006: Investigated two-beam propagation techniques. Investigated critical advanced wavefront control devices for both monolithic and phased array imaging and beam projection from space.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: 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.	1.905	0.000	0.000	0.000
(U) In FY 2006: Assessed the survivability and vulnerability of aerospace systems to the effects of high-energy laser and other directed energy systems. Updated response databases for continued improvement of predictive avoidance analyses and provided data to U.S. Strategic Command for the performance of Laser Clearinghouse functions. Updated previously completed assessments on catalogued satellites. Enhanced and refined 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. Updated assessment methodology by anchoring modeling tools to empirical data. Incorporated improved algorithms and hardware for rapidly characterizing space objects and new launches into current data				

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2007**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602500F MULTI-DISCIPLINARY SPACE TECH**	**5023 Laser & Imaging Space Tech**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	fusion workstations needed for satellite assessments and for the space situational awareness mission.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	7.701	0.000	0.000	0.000

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602500F MULTI-DISCIPLINARY SPACE TECH**	**5025 Space Materials Development**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5025 Space Materials Development	19.197	0.000	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	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop materials and processes to dramatically improve performance, durability, and cost of rocket propulsion systems.	10.899	0.000	0.000	0.000
(U) In FY 2006: Evaluated suitability of materials for high-speed turbopumps, ducts, valves, solid rocket casings, insulation, nozzle throats, and spacecraft propulsion applications. Fabricated subscale articles and tested in representative rocket engine environment to validate materials performance. Analyzed material behavior in rocket combustion environment for solid rocket nozzles, exit cones, throats, and spacecraft propulsion components. Validated materials performance goals for direct replacement of materials. Evaluated processes for scale-up from coupon-level testing to more complex shapes and sizes. Demonstrated innovative concepts and technologies that could enable new engine designs. Characterized material candidates, analyzed material performance, and identified ways to improve thrust chambers, nozzles, and catalysts.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) MAJOR THRUST: Develop affordable, advanced structural and non-structural materials and processing technologies for Air Force space applications.	6.777	0.000	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2006: Developed candidate metallic systems for thin gage structures for component operation in robust high-temperature, long duration cruise or access to space environments. Refined analytical methods to understand behavior of materials in cryogenic environments and analyzed liquid oxygen compatibility research results through integrated technical working groups with industry and National Aeronautics and Space Administration (NASA). Developed subscale high-temperature protection systems for leading edges, nosetips, and aeroshells for expendable and reusable high-speed vehicle applications. Demonstrated oxidation-protected carbon-carbon materials in environments relevant to high-speed vehicle applications. Developed advanced composite technologies for thermal management and dimensionally stable structural space applications. Developed wear-resistant materials, lubricants, and micro-electro-mechanical systems devices for moving mechanical assemblies on spacecraft. Evaluated candidate space materials and collected critical data to facilitate materials transition.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: 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.	1.521	0.000	0.000	0.000
(U)	In FY 2006: Demonstrated electro-optic polymers for optical communications, data links, and radio frequency (RF) system control architectures. Explored processes to allow advanced materials design and architecture development for very long wavelength alternative materials operating at 40 Kelvin. Developed materials and materials process technologies for application in combined optical and RF communication system apertures.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	19.197	0.000	0.000	0.000

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602102F, Materials.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

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

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5026	Rocket Propulsion Component Tech	48.113	0.000	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	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. Funds for the 2007 Congressionally-directed Engineering Tool Improvement Program (ETIP) in the amount of $2.8 million were moved from this Project to PE 0602203F, Aerospace Propulsion, Project 6233SP, Space Rocket Component Technology, for execution.

(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 2006	FY 2007	FY 2008	FY 2009
(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.	3.420	0.000	0.000	0.000
(U) In FY 2006: Downselected potential propellant ingredients and scaled-up promising high energy-density materials candidates. Evaluated propellants in advanced combustion devices to determine materials compatibility and performance and prepare for large-scale motor tests. Incorporated initial solid propellants ingredients into Phase III solid propellant formulations. Completed 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 2007: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5026 Rocket Propulsion Component Tech**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: 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.	7.900	0.000	0.000	0.000
(U)	In FY 2006: Characterized, studied, and evaluated shear coaxial injector performance to ensure chamber/injector compatibility and prevent damage to upper stage engines. Developed experiments to enhance the thermal management of upper stage engines for better performance, chamber life, and reliability. Analyzed and tested 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. Developed advanced synthetic hydrocarbon fuels to meet Phase II goals.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: 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.	5.147	0.000	0.000	0.000
(U)	In FY 2006: Developed advanced, recyclable, ablative components using nano-reinforced hybrid polymers that are two times better than previously developed materials. Characterized and developed processing technologies to improve nano-reinforced high temperature polymers and carbon-carbon materials. Developed new advanced materials for use with high-energy propellants. Completed transition of specific advanced high temperature materials to air and space systems to reduce system weight and cost, and increase performance. Developed processing methodology for using nanocomposites for liquid rocket engine tanks.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(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.	19.189	0.000	0.000	0.000
(U)	In FY 2006: Developed advance modeling and simulation tool for advanced cryogenic liquid rocket upper stage technologies. Designed hardware for advanced cryogenic upper stage technologies - turbopumps and thrust chambers. Evaluated second set of potential hydrocarbon fuels and adjust/modify/develop fuel characterization test rig. Developed second concept for lightweight nozzles for liquid rocket engines.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: 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.	4.219	0.000	0.000	0.000
(U)	In FY 2006: Completed initial development and test of monopropellant thruster ignition and combustion sustainment component technologies for chemical-based space propulsion. Completed Phase II lifetest and evaluated Phase III plasma thrusters for microsatellites propulsion systems. Completed development and test of a controlled solid propellant.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Engineering Tool Improvement Program (ETIP).	4.168	0.000	0.000	0.000
(U)	In FY 2006: Provided additional modeling and simulation tool development for Hall-effect thruster physical models, improvements to the ROCket Engine Transient Simulation (ROCETS) graphical user interface, and added rocket-based combined cycle models to the Integrated Propulsion Analysis Tool code for future fully reusable launch vehicle concepts. Added capability to analyze advanced propulsion concepts such as Field Reversed Configuration.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5026 Rocket Propulsion Component Tech**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Universal Small Launch Vehicle	4.070	0.000	0.000	0.000
(U)	In FY 2006: Integrated 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	48.113	0.000	0.000	0.000

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0601102F, Defense Research Sciences.										
(U)	PE 0602114N, Power Projection 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.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5027	High Speed Airbreathing Prop Tech	0.239	0.000	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	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 2006	FY 2007	FY 2008	FY 2009
(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.	0.239	0.000	0.000	0.000
(U)	In FY 2006: 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 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	0.239	0.000	0.000	0.000

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0601102F, Defense Research Sciences.										
(U)	PE 0602201F, Aerospace										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

Flight Dynamics.

(U) PE 0602203F, Aerospace 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 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602500F MULTI-DISCIPLINARY SPACE TECH**	**5028 Space Sensors, Photonics & RF Proc**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5028	Space Sensors, Photonics & RF Proc	1.848	0.000	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	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. Funds for the 2007 Congressionally-directed Integrated Control for Autonomous Space Systems in the amount of $1.6 million were moved from this Project to PE 0602601F, Space Technology, Project 628809, Spacecraft Vehicle Technology, for execution.

(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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Study adaptive processing techniques for large, multi-mission, space-based conformal arrays.	1.000	0.000	0.000	0.000
(U) In FY 2006: 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. Studied signal processing methods and novel adaptive transmit waveform techniques for a space surveillance platform.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: 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 moved into this thrust from previous major thrusts in this Project.	0.848	0.000	0.000	0.000
(U) In FY 2006: Developed and demonstrated photonic component technology enabling low loss true time delay for wideband phased array applications.				
(U) In FY 2007: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5028 Space Sensors, Photonics & RF Proc**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	1.848	0.000	0.000	0.000

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										
(U)	This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE
February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602500F MULTI-DISCIPLINARY SPACE TECH**	**5029 Space Sensor & CM Tech**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5029 Space Sensor & CM Tech	1.074	0.000	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	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 2006	FY 2007	FY 2008	FY 2009
(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 completed.	0.339	0.000	0.000	0.000
(U) In FY 2006: Demonstrated highly accurate and robust precision time, position, and velocity sensor techniques for space-based applications. Developed 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) In FY 2008: Not Applicable.				
(U) In FY 2009: 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 reconnaissance capability.	0.735	0.000	0.000	0.000
(U) In FY 2006: Developed low-mass shallow-depth microwave antenna panels with integrated active elements and low RF distribution loss.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U) Total Cost	1.074	0.000	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5029 Space Sensor & CM Tech**

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE **February 2007**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602500F MULTI-DISCIPLINARY SPACE TECH**	**5082 Optical Networking Tech**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5082 Optical Networking Tech	11.589	0.000	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	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 2006	FY 2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Develop and assess optical network technologies for application in the space environment.	1.511	0.000	0.000	0.000
(U)	In FY 2006: Designed and developed a multi-path interconnection network that provides for redundancy, fault tolerance, self-routing and non-blocking switching required for air and space-based networks. Demonstrated a 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: 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.	2.926	0.000	0.000	0.000
(U)	In FY 2006: Demonstrated industry standard single mode optical communications bus interface chip for airborne platforms. Designed and developed optical burst switching and optical label switching protocols for applicability to air and space-based optical networks. Performed a flight demonstration of				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	industry standard single mode optical communications bus interface chip for airborne platforms.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: 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.	4.050	0.000	0.000	0.000
(U)	In FY 2006: Designed and developed waveform, coding, management, and atmospheric mitigation technologies for a combined RF/laser communications brassboard. Characterized and developed an 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Space Qualification of the Common Data Link.	3.102	0.000	0.000	0.000
(U)	In FY 2006: Modified the Common Data Link (CDL), previously developed for Joint Surveillance and Target Attack Radar System, U-2, Global Hawk, and Airborne Warning and Control System, and performed qualifications testing for operation in the space environment. Enhanced current CDL capabilities by developing higher throughput space qualifiable terminals to enable airborne and surface CDL terminals to receive direct downlinks for space borne assets				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	11.589	0.000	0.000	0.000

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	PE 0602702F, Command, Control, and Communications.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602500F MULTI-DISCIPLINARY SPACE TECH**	PROJECT NUMBER AND TITLE **5082 Optical Networking Tech**

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

(U) PE 0603789F, C3I Advanced Development.

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

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Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
02 Applied Research

PE NUMBER AND TITLE
0602601F Space Technology

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	103.604	103.472	109.566	106.755	123.509	123.927	125.251	128.550	Continuing	TBD
1010	Space Survivability & Surveillance	47.152	48.567	43.484	46.991	46.119	46.968	48.596	49.893	Continuing	TBD
4846	Spacecraft Payload Technologies	16.314	17.150	22.949	21.877	24.050	24.224	25.181	25.755	Continuing	TBD
5018	Spacecraft Protection Technology	2.129	1.923	2.548	3.503	3.831	3.840	4.657	4.754	Continuing	TBD
8809	Spacecraft Vehicle Technologies	38.009	35.832	40.585	34.384	49.509	48.895	46.817	48.148	Continuing	TBD

Note: Funds for the FY 2007 Congressionally-directed Integrated Control for Autonomous Space Systems in the amount of $1.6 million were moved from PE 0602500F, Multi-Disciplinary Space Technology, Project 625028, and funds for the Center for Solar Electricity and Hydrogen in the amount of $3.6 million were moved from PE 0602203F, Aerospace Propulsion, Project 6233SP, to this PE for execution. Also, funds for the FY 2007 Congressionally-directed Space-Qualified Common Data Link in the amount of $2.2 million were moved from this PE to PE 0602702F, Command, Control and Communications, Project 6266SP, 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 2007, Congress added $1.0 million for Elastic Memory Composites, $1.1 million for Three Dimensional Deployable Structure Systems for Space, $0.3 million for Shielding Rocket Payloads, $1.0 million for Multicontinuum Technology for Space Structures, $1.1 million for Deployable Structures Experiment, $1.0 million for Field Programmable Gate Array, $1.0 million for Flexible CIGS Solar Cells on Silicon Substrates for Spacecraft, $3.2 million for High-frequency Active Auroral Research Program (HAARP), $1.0 million for Joint Micro Power Initiative, $1.1 million for Nanoscale Microelectronic Circuit Technology Development, $1.3 million for USAF National Security Research - Signature, and $2.2 million for Space-Qualified Common Data Link. 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.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**

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

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	104.392	85.594	114.195	129.471
(U)	Current PBR/President's Budget	103.604	103.472	109.566	106.755
(U)	Total Adjustments	-0.788			
(U)	Congressional Program Reductions		-0.015		
	Congressional Rescissions	-0.017	-0.392		
	Congressional Increases		15.285		
	Reprogrammings	0.680	3.000		
	SBIR/STTR Transfer	-1.451			

(U) Significant Program Changes:

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 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **1010 Space Survivability & Surveillance**	

Cost ($ in Millions)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
1010	Space Survivability & Surveillance	47.152	48.567	43.484	46.991	46.119	46.968	48.596	49.893	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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.	4.104	5.215	6.854	8.649
(U) In FY 2006: Developed initial multi-sensor global data assimilation models for real-time situational awareness of energetic electron hazards to space systems. Validated dynamic radiation belt specification and forecast model with data from geosynchronous and low-earth orbit DoD satellites. Completed physical design and accomplished Preliminary Program Design Review of next generation, high-resolution solar telescope. Developed 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. Completed 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. 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) In FY 2008: Complete detailed analysis of Solar Mass Ejection Imager. Compile specifications and guidance for operational heliospheric imager. Initiate measurement of interplanetary magnetic fields				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **1010 Space Survivability & Surveillance**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	using wide-field radio array. Initiate development of magnetic reconnection model to study solar flare initiation and energy storage. Initiate program to test and evaluate empirical flare prediction models based on synoptic data from Air Force and national observatory assets. Complete 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. Continue coupling of radiation belt model to global geospace environment models to increase accuracy and lead time. Validate models for ionospheric penetration by very low frequency (VLF) electromagnetic waves and their injection into the magnetosphere.				
(U)	In FY 2009: Continue measurement of interplanetary magnetic fields using wide-field radio array. Complete Spiral 1 magnetic reconnection model to study solar flare initiation and energy storage. Continue program to test and evaluate empirical flare prediction models based on synoptic data from Air Force and national observatory assets. Complete coupling of radiation belt model to global geospace environment models to increase accuracy and lead time. Utilize three-dimensional global radiation belt diffusion models to simulate ultimate global effect of wave-particle interactions from VLF electromagnetic wave power injected in narrow altitude slices of radiation belts. Validate models for virtual VLF electromagnetic wave generation in the ionosphere and global transport and power distribution.				
(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.	13.882	16.942	13.617	14.236
(U)	In FY 2006: Developed technologies for visible to infrared wavelength sensing for space-to-space resident space object characterization. Using available airborne and spaceborne data, validated daytime spectral processing algorithms and related signature databases for remaining terrain classes. Used test data and validated simulations to evaluate candidate sensor technologies for spectral theater surveillance and area search missions. Developed real-time hypertemporal processing algorithms and determine optimal parameters for operational system. Improved turbulence forecasting skill, as required, and assisted in transition of airborne laser decision aid for testing to operational decision aid status. Performed case studies on existing and improved stratospheric clear air turbulence forecast tools. Addressed decision aid requirements for tactical high-energy lasers and laser communication systems.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **1010 Space Survivability & Surveillance**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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 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)	In FY 2008: Finalize real-time hypertemporal (HT) processing algorithms with optimal parameters for space-based missile launch detection. Continue development of third-generation brassboard HT sensor for space-based missile launch detection. Begin feasibility study of HT applications for technical intelligence from ground, air, and space-based platforms. Use satellite tracking test bed and Air Force Maui Optical and Supercomputing tracking telescopes to demonstrate Space Situational Awareness (SSA) capability of HT sensors and validate the utility of this technique to obtain operational and health status of resident space objects. Other advanced sensors of spectral, polarimetric and temporal capabilities are considered in the down selection phase and tested with ground systems as needed. Complete analysis of space data on real world detections of resident space objects with multiple band thermal infrared, visible, and ultraviolet and develop models of sensor performance to evaluate capability of space-based sensors. Utilize planned space demonstrations to validate spectral theater surveillance and area search missions and supporting models. Continue transition of spectral image processing and exploitation algorithms and related signature databases to Government users. Begin investigation of spectral applications for material identification in support of military chemical/biological weapons detection and identification in the thermal infrared and other bands.				
(U)	In FY 2009: Finalize brassboard HT sensor for space-based missile launch detection. Incorporate latest real-time HT processing algorithms into sensor platform. Transition brassboard sensor and algorithms to customer for space-based missile launch detection. Test feasibility of HT applications for technical intelligence from ground, air, and space-based platforms. Define the requirements and the optimum				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	configuration of a space-based HT sensor. Develop end-to-end simulation capability, based on the sensor performance models, to assist acquisition community and space operator community in trade space analyses of sensors or sensor suites. The emphasis is on the capabilities to derive information and intelligence about space objects with signals in all bands and all temporal regimes. Continue investigation of spectral applications for material identification in support of military chemical/biological weapons detection and identification in the thermal infrared and other bands. Complete transition of spectral image processing and exploitation algorithms and related signature databases to Government users. Complete analysis and documentation of military utility of planned space demonstrations of spectral theater surveillance and area search missions. Complete validation of hyperspectral models.				
(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.	7.650	5.615	7.065	7.305
(U)	In FY 2006: Generated 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. Performed 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. Developed statistical database and tools to track C/NOFS forecast metrics to assess military utility of outage warning due to scintillation. Developed technology to produce artificial ionization patches for use in over-the-horizon radar/comm applications and to mitigate scintillation conditions. Developed 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)	In FY 2008: Expand high-latitude data collection to initiate a high-latitude scintillation warning system.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Investigate the impact of convection of scintillations to higher latitudes on Ultra High Frequency communication and Global Positioning System (GPS) navigation systems. Investigate HF induced artificial scintillation generation using the High-frequency Active Auroral Research Program (HAARP). Develop portable ionospheric sensor suite for measuring total electron content and communications/navigation scintillation. Initiate space radar data collection for ionosphere compensation study. Develop scintillation mitigation technology by using metal-oxide space cloud. Develop techniques of analyzing GPS radio occultation data acquired by C/NOFS and Constellation Observing System for Meteorology, Ionosphere and Climate (COSMIC) satellites. Begin incorporation of Kalman filter ionospheric model into forecast models and ionospheric warfighter impact products. Conduct statistical analysis of neutral density to improve accuracy of empirical neutral density models for specifying and forecasting neutral density during geomagnetic storms. Implement algorithm to assess impacts of penetration electric fields on generation of equatorial irregularities.				
(U)	In FY 2009: Investigate solar activity on enhancement of L-band scintillations to assess the support of the scintillation database and tools to military communication and navigation systems. Measure total electron content and scintillations over the African subcontinent for better defining the equatorial scintillation and GPS error environment in the middle-eastern region. Demonstrate scintillation mitigation technology using metal-oxide space cloud. Deliver ionospheric compensation technique with wide-band radio-frequency waves. Improve modeling techniques for specifying high temporal resolution of neutral density and satellite drag to achieve predictive space situation awareness. Improve empirical and neutral density model based on Atmospheric Density Specification experiment data and develop physics-based model of the neutral composition, wind, and density. Continue transition of physics-based 3-D model of equatorial plasma bubbles into warfighter products and transition of ionospheric Kalman filter operational models into equatorial models.				
(U)					
(U)	MAJOR THRUST: Develop High-frequency Active Auroral Research Program site transmitting and diagnostic instrument infrastructure.	10.000	9.475	9.128	9.942
(U)	In FY 2006: Completed 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)	In FY 2008: Conduct experimental research with the 3.6 megawatt transmitting array to develop				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	techniques to increase the efficiency of ELF/VLF wave generated in space and initiate research to characterize their interactions with charged particles in the earth's radiation belts.				
(U)	In FY 2009: Continue research to characterize wave-particle interactions and wave amplification effects in space and their potential application to mitigate charged particle effects on space systems and operations.				
(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.	6.849	6.837	6.820	6.859
(U)	In FY 2006: Provided further updated seismic codes for operational use. Focused on seismic energy partition, magnitudes, and source physics moves from hypothesis development towards major hypothesis flyoff. Continued efforts on seismic calibration; seismic detection, location, and discrimination; and observational studies of seismic wave propagation, including propagation in Eurasia. Focused on transition between local and regional seismic wave propagation and implications for all topics above. Assessed 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)	In FY 2008: Test and incorporate new research methods for automated processing of increasing numbers of seismic events. Develop long-period regional seismic discrimination, while examining challenges in high-frequency regional discrimination. Continue efforts on seismic calibration; seismic detection, location, and discrimination; and observational studies of seismic wave propagation, including propagation in Eurasia. Conduct comprehensive studies to transition the program to meet emerging local seismic monitoring requirements. Design and conduct theoretical, laboratory, and field studies to support local monitoring.				
(U)	In FY 2009: Flyoff different techniques for automated processing of increasing numbers of seismic events. Conduct detailed research on causes of challenges in high-frequency regional discrimination. Further continue efforts on seismic calibration; seismic detection, location, and discrimination; and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	observational studies of seismic wave propagation, including propagation in Eurasia. Continue to conduct detailed studies of particular challenge areas in local seismic monitoring. Refine design and conduct theoretical, laboratory, and field studies to support local monitoring.				
(U)					
(U)	CONGRESSIONAL ADD: High-frequency Active Auroral Research Program.	3.306	3.188	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for HAARP.				
(U)	In FY 2007: Conduct Congressionally-directed effort for HAARP.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: USAF Center for National Security Research - Signature.	1.361	1.295	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for National Security Research - Signature Exploitation.				
(U)	In FY 2007: Conduct Congressionally-directed effort for USAF National Security Research - Signature.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	47.152	48.567	43.484	46.991

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0305111F, Weather Systems.										
(U)	PE 0305160F, Defense Meteorological Satellite Program.										
(U)	PE 0601102F, Defense Research Sciences.										
(U)	PE 0602204F, Aerospace Sensors.										
(U)	PE 0603401F, Advanced										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

Spacecraft Technology.

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602601F Space Technology**	**4846 Spacecraft Payload Technologies**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4846 Spacecraft Payload Technologies	16.314	17.150	22.949	21.877	24.050	24.224	25.181	25.755	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: Funds for the FY 2007, Congressionally-directed Space-Qualified Common Data Link in the amount of $2.2 million were moved from this Project to PE 0602702F, Command, Control and Communications, Project 6266SP, for execution.

(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 2006	FY 2007	FY 2008	FY 2009
(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.	3.636	3.200	4.166	4.976
(U) In FY 2006: Performed studies in metal films. Demonstrated two-layer single-pixel polarimeter. Improved quantum dot detector responsivity. Characterized superlattice detectors. Investigated magnetic and electric field tuning of detector wavelength responsivity ("wavelength agility"). Performed comparisons of emerging detector technologies for transfer to applied research. Characterized and assessed 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 focal plane arrays (FPAs). Pursue long-wave infrared (LWIR) superlattice defect reduction and passivation optimization.				
(U) In FY 2008: Continue investigating spectral agility. Begin investigating field-enhancement technologies. Demonstrate a three-layer single pixel polarimeter. Continue LWIR superlattice defect reduction and passivation optimization.				
(U) In FY 2009: Continue investigating spectral agility. Demonstrate tuning from 15 to 20 microns in 1 micron increments. Continue investigating field enhancement technologies. Demonstrate amplification				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	using quantum interference and demonstrate enhancement using plasmons. Continue investigating the single pixel polarimeter. Demonstrate improved LWIR superlattice detector and assess very long-wave infrared feasibility.				
(U)					
(U)	MAJOR THRUST: Develop spectral sensing and data exploitation methodologies for military imaging and remote sensing applications.	0.987	0.868	1.137	1.225
(U)	In FY 2006: Completed development and continued validation of polarimetric scene modeling capability for space-based surveillance applications. Integrated additional models for accurate prediction of satellite materials signatures and compared with available laboratory and field data. Completed development of instrument models for staring polarimetric surveillance systems. Developed 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)	In FY 2008: Begin development of a predictive model for advanced imaging concepts. Using the physics-based models, develop an end-to-end capability to predict the performance, benefit, and cost of various sensors for Intelligence, Surveillance, and Reconnaissance (ISR) and SSA applications.				
(U)	In FY 2009: Complete the development and begin the validation of a predictive model for advanced imaging. Validate against laboratory and available field data of ISR and SSA missions. Make improvements to the simulation capability to improve accuracy and usability of the model. Utilize the prediction capability to develop concepts for purpose built sensors for SSA.				
(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.	4.129	2.985	3.706	3.834
(U)	In FY 2006: Designed new chalcogenide materials for reconfigurable radio frequency (RF) circuits and for reconfigurable wiring. Developed fundamental understanding of exotic high-dielectric constant materials and predicted candidate materials for insertion into aggressively scaled electronic devices for space electronics. Researched radiation effects in highly integrated microelectronics employing the most recent techniques in power management, clock domain partitioning, and monolithic integration of				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **4846 Spacecraft Payload Technologies**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	multiple radio frequency, analog, and digital functions. Identified and evaluated radiation hardening techniques for enhancing immunity to single event and other radiation effects arising from the natural space environment, as well as nuclear events. Developed a "liquid manifold" approach based 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)	In FY 2008: Initiate capabilities to the current Satellite Design Automation software to evolve a logical sequence to form a "push-button toolflow" satellite builder. Initiate Radiation-harden space sensor interface modules allocating standardized data messages protocols from sensors for ease device control of sensors and actuators.				
(U)	In FY 2009: Complete capabilities to the current Satellite Design Automation software to evolve a logical sequence to form a "push-button toolflow" satellite builder. Demonstrate radiation-harden space sensor interface modules allocating standardized data messages protocols from sensors for ease device control of sensors and actuators.				
(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. Note: In FY 2008, increase in funding is due to acceleration of the development of engineering and military utility models for space superiority analysis of space situational awareness and defensive counterspace technologies.	2.441	2.501	6.428	3.508
(U)	In FY 2006: Supported autonomous and responsive space flight experiments with simulations and data validation. Extended the simulation architecture to feed engineering-level data to mission/campaign models. Extended the architecture to address missions associated with space situational awareness and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	tactical surveillance. Developed enhancements to imaging system simulations to include polarimetric and hyperspectral effects. Tailored 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)	In FY 2008: Complete support of autonomous and responsive space flight experiments with simulations and data validation. Complete extension of the simulation architecture to feed engineering-level data to mission/campaign models. Begin to develop engineering and military utility models for space superiority analysis of space situational awareness and defensive counterspace technologies.				
(U)	In FY 2009: Continue to develop engineering and military utility models for space superiority analysis of space situational awareness and defensive counterspace technologies.				
(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.	5.121	5.504	7.512	8.334
(U)	In FY 2006: Verified initial standards of combining multiple airborne intelligence, surveillance and reconnaissance and space asset feeds into a single optical data path. Performed 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)	In FY 2008: Begin integration of single-access laser communications terminal components into multi-access laser communications terminal.				
(U)	In FY 2009: Complete integration of single-access laser communications terminal components into multi-access laser communications terminal.				
(U)					
(U)	CONGRESSIONAL ADD: Field Programmable Gate Arrays.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Field Programmable Gate Arrays.				
(U)	In FY 2008: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **4846 Spacecraft Payload Technologies**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Nanoscale Microelectronic Circuit Technology Development.	0.000	1.096	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Nanoscale Microelectronic Circuit Technology Development.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	16.314	17.150	22.949	21.877

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0603401F, Advanced Spacecraft Technology.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2007**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602601F Space Technology**	**5018 Spacecraft Protection Technology**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5018 Spacecraft Protection Technology	2.129	1.923	2.548	3.503	3.831	3.840	4.657	4.754	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop key satellite threat warning technologies and tools for high value satellite asset defense.	0.808	0.846	1.026	1.115
(U) In FY 2006: Processed integrating most promising proximity or threat warning sensor into a space experiment. Identified 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 testing and analysis. Identify technology transition opportunities.				
(U) In FY 2008: Continue to conduct sensor space flight experiment and analysis. Identify technology transition opportunities and provide associated engineering designs and concepts.				
(U) In FY 2009: Transfer an active and/or passive threat warning sensor for detection of a direct assent or co-orbital vehicle and transition these engineering designs.				
(U)				
(U) MAJOR THRUST: Develop high value space asset defensive capabilities.	0.529	0.548	0.870	1.678
(U) In FY 2006: Downselected to the most promising defensive technology for space experiment planning and integration. Identified 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 analysis. Identify technology transfer opportunities.				
(U) In FY 2008: Develop space experiment using onboard systems or develop proof of concept space experiment to validate concept and multiple use technology.				
(U) In FY 2009: Identify two technology options that provide defensive capability for incorporation into geosynchronous orbit/low earth orbit satellites and complete engineering designs.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **5018 Spacecraft Protection Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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.	0.522	0.529	0.652	0.710
(U)	In FY 2006: Developed space experiment of existing cooperative onboard system or developed proof of concept space experiment to validate concept.				
(U)	In FY 2007: Conduct defensive technology space demonstration and analysis. Identify technology transfer opportunities.				
(U)	In FY 2008: Transition technology to other compatible space systems for multiple uses.				
(U)	In FY 2009: Identify technology transition opportunities and provide engineering designs to potential users.				
(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 completed in FY 2006.	0.270	0.000	0.000	0.000
(U)	In FY 2006: Conducted space experiment demonstration of C/NOFS. Assessed 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	2.129	1.923	2.548	3.503

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	PE 0603401F, Advanced Spacecraft Technology.										
(U)	This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **5018 Spacecraft Protection Technology**

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: **February 2007**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602601F Space Technology**	**8809 Spacecraft Vehicle Technologies**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
8809 Spacecraft Vehicle Technologies	38.009	35.832	40.585	34.384	49.509	48.895	46.817	48.148	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: Funds for the FY 2007 Congressionally-directed Integrated Control for Autonomous Space Systems in the amount of $1.6 million were moved from PE 0602500F, Multi-Disciplinary Space Technology, Project 625028, and funds for the Center for Solar Electricity and Hydrogen in the amount of $3.6 million were moved from PE 0602203F, Aerospace Propulsion, Project 6233SP, to this Project, 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 2006	FY 2007	FY 2008	FY 2009
(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.	3.586	3.175	4.434	4.536

(U) In FY 2006: Built experimental capabilities for flow field measurements in pulse tube cryocoolers. Refined and validated cryocooler component and system models with experimental data. Investigated thermodynamic loss mechanisms in regenerative cycle cryocoolers through computational fluid dynamics models. Demonstrated 12% efficient thin-film solar cell on polymer substrate. Demonstrated 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) In FY 2008: Continue to refine and validate cryocooler component and system models with experimental data. Complete theoretical model of multistage cooler energy flows. Continue to investigate thermodynamic loss mechanisms in regenerative cycle cryocoolers through computational fluid dynamics models. Complete definition and begin procurement technology development design work for improved short-wavelength infrared/medium-wavelength infrared (SWIR/MWIR) cryocooler application needs for missile launch detection and technical intelligence missions. Develop advanced

(U)	**B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
	concept solar cells traceable to efficiencies greater than 40%.				
(U)	In FY 2009: Further refine and validate cryocooler component and system models with experimental data. Continue to investigate thermodynamic loss mechanisms in regenerative cycle cryocoolers through computational fluid dynamics models. Complete design work for improved SWIR/MWIR cryocooler application for missile launch detection and technical intelligence mission systems. Complete engineering demonstration of advanced array for thin-film solar cells scaleable to greater than 100 kw.				
(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 composite satellite and launch vehicle structures.	6.364	5.702	10.634	15.570
(U)	In FY 2006: Developed advanced mechanisms and guidance strategies for capture and servicing of disabled (non-cooperative) spacecraft. Developed 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)	In FY 2008: Complete characterization of thermal protection structural performance. Provide autonomy concepts to support defensive/protection actions by spacecraft. Begin development of multifunctional structural hardware concepts for space situational awareness, such as structural health monitoring, light occultation by nearby objects, and detection of RF emissions. Begin development of system-level architectures for large precision deployable structures. Begin development of advanced estimation algorithms for better local situational awareness using existing and next-generation hardware, such as star-trackers for object detection, characterization, and tracking.				
(U)	In FY 2009: Continue development of multifunctional structural hardware concepts for space situational awareness, such as structural health monitoring, light occultation by nearby objects, and detection of RF emissions. Continue development of system-level architectures for large precision deployable structures. Continue development of advanced estimation algorithms for better local situational awareness using existing and next-generation hardware, such as star-trackers for object detection, characterization, and tracking.				
(U)					
(U)	MAJOR THRUST: Develop flight experiments to address key scientific and technological problems in	10.949	15.314	25.517	14.278

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **8809 Spacecraft Vehicle Technologies**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	order to improve the capabilities of existing operational space systems and to enable new transformational space capabilities. Note: Funding changes are due to launch preparation activities and higher Air Force priorities.				
(U)	In FY 2006: Completed fabrication of spacecraft structure. Built and tested core spacecraft and experimental payloads. Completed mission planning and on-orbit operations guide. Completed spacecraft system Preliminary Design Review to freeze all interfaces. Advanced 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 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)	In FY 2008: Complete delivery of all spacecraft payloads. Complete spacecraft assembly, integration and test. Train mission operations team for on-orbit activities. Prepare science teams for on-orbit operations using simulated data to certify the dissemination and analysis process.				
(U)	In FY 2009: Prepare spacecraft for launch. Complete all spacecraft to launch vehicle interface analysis and approval. Launch spacecraft and commence with Mission Operations.				
(U)					
(U)	CONGRESSIONAL ADD: Converted Silicon Carbide for High Performance Optic Structures.	4.277	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Converted Silicon Carbide for High Performance Optic Structures.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Consortium for Autonomous Satellite Systems (CASS).	1.459	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for CASS.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Large Aperture Deployable Structure Systems for Space.	1.944	0.000	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **8809 Spacecraft Vehicle Technologies**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2006: Conducted Congressionally-directed effort for Large Aperture Deployable Structure Systems for Space.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Nano-Reinforced Structures and Advanced Multi-Functional Structures for Space Programs.	2.333	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Nano-Reinforced Structures and Advanced Multi-Functional Structures for Space Programs.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Integrated Control for Autonomous Space Systems (ICASS).	2.430	1.594	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for ICASS.				
(U)	In FY 2007: Conduct Congressionally-directed effort for ICASS.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Elastic Memory Composites (EMC).	1.459	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Elastic Memory Composites.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Elastic Memory Composites.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Deployable Structures Experiment.	2.236	1.096	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Deployable Structures Experiment.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Deployable Structures Experiment.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **8809 Spacecraft Vehicle Technologies**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)					
(U)	CONGRESSIONAL ADD: Lightweight Photovoltaic Electricity and Hydrogen for Portable, On-Demand Power/Center for Solar Electricity and Hydrogen.	0.972	3.587	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for lightweight photovoltaic electricity and hydrogen for portable, on-demand power.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Center for Solar Electricity and Hydrogen.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Flexible CIGS Solar Cells on Silicone Substrates for Spacecraft.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Flexible CIGS Solar Cells on Silicone Substrates for Spacecraft.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Joint Micro Power Initiative.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Joint Micro Power Initiative.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Multicontinuum Technology for Space Structures.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Multicontinuum Technology for Space Structures.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Shield Rocket Payloads.	0.000	0.284	0.000	0.000
(U)	In FY 2006: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2007: Conduct Congressionally-directed effort for Shield Rocket Payloads.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Three Dimensional Deployable Structure Systems for Space.	0.000	1.096	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Three Dimensional Deployable Structure Systems for Space.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	38.009	35.832	40.585	34.384

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification

DATE: **February 2007**

BUDGET ACTIVITY
02 Applied Research

PE NUMBER AND TITLE
0602602F Conventional Munitions

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	58.012	61.868	57.804	56.081	59.521	59.540	60.182	62.187	Continuing	TBD
2068	Advanced Guidance Technology	18.554	17.889	17.891	18.015	19.180	19.238	19.644	20.091	Continuing	TBD
2502	Ordnance Technology	39.458	43.979	39.913	38.066	40.341	40.302	40.538	42.096	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. 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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	62.061	62.105	58.771	59.318
(U)	Current PBR/President's Budget	58.012	61.868	57.804	56.081
(U)	Total Adjustments	-4.049			
(U)	Congressional Program Reductions		-0.002		
	Congressional Rescissions	0.038	-0.235		
	Congressional Increases		1.300		
	Reprogrammings	-3.321	-1.300		
	SBIR/STTR Transfer	-0.766			

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602602F Conventional Munitions**	PROJECT NUMBER AND TITLE **2068 Advanced Guidance Technology**	

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2068	Advanced Guidance Technology	18.554	17.889	17.891	18.015	19.180	19.238	19.644	20.091	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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.	6.088	6.712	5.621	5.080

(U) In FY 2006: Incorporated and tested improved components in laser ranging and detection seekers with goal to provide "single-shot" imaging at useful ranges. Completed testing of a low-cost synthetic aperture radar seeker. Fabricated an optical seeker that uses multi-discriminate signatures to improve targeting against obscured targets. Using ground test data, augmented 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" imaging. 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) In FY 2008: Test and demonstrate in a lab environment test components for laser ranging seeker to provide "single shot" imaging at useful ranges. Lab test an optical seeker that uses multi-discriminate signatures to improve targeting of obscured targets. Develop Synthetic Aperture Radar (SAR) system simulation for designing Radar Frequency (RF) seeker technologies analysis.

(U) In FY 2009: Laboratory demonstration of test components for laser ranging seeker to profile "single shot" images of useful targets. Test and demonstrate an optical seeker that uses multi-discriminate signatures to improve targeting obscure targets. Refine SAR System simulation. Begin developing a

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602602F Conventional Munitions**	PROJECT NUMBER AND TITLE **2068 Advanced Guidance Technology**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	multi mode seeker that provides improved performance in two wavelength bands.				
(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 enhance strike aircraft effectiveness and survivability.	3.420	3.800	3.300	3.455
(U)	In FY 2006: Developed navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from Global Positioning System (GPS). Developed guidance techniques for small agile vehicles in close proximity to cluttered terrain. Investigated the neuro-physiology of insects for application to guidance, particularly engaging moving ground targets. Evaluated 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)	In FY 2008: Test navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Continue applying neuro-physiology of insects to guide small vehicles for moving targets in urban like environments. Continue novel evaluating navigation system within GPS jamming environments. Investigate using data links to provide target location updates for precision strike against mobile, time sensitive targets.				
(U)	In FY 2009: Continue applying the neuro-physiology of insects to guide small vehicles to moving targets in urban like environments. Continue evaluating navigation systems within GPS jamming environments. Evaluate utility data links to provide target location updates for precision strike against time sensitive targets. Investigate guidance navigation and control algorithms for engaging high agility, reduced signature targets. Investigate technologies applicable to indoor navigation within facilities.				
(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	2.803	2.809	3.570	3.851

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602602F Conventional Munitions**	PROJECT NUMBER AND TITLE **2068 Advanced Guidance Technology**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	guidance and control. These seekers will deny an enemy the ability to hide or camouflage a target, while also decreasing aircrew workload.				
(U)	In FY 2006: Furthered biomimetic principles by developing modular models to investigate particular target attributes. Investigated polarization techniques to develop model behavior theory. Developed in-house capability to evaluate contractor developed optic-flow algorithms.				
(U)	In FY 2007: Continue investigating particular target attributes using biomimetic principles. Continue developing polarization behavior theory models. Continue to evaluate contractor developed optic-flow algorithms.				
(U)	In FY 2008: Verify biomimetic models through simulation. Continue developing polarization behavior theory models. Develop an optical flow enhanced seeker.				
(U)	In FY 2009: Continue verifying biomimetic models through simulation and field testing. Verify polarization theory models through simulation. Conduct tests on an optical flow enhanced seeker.				
(U)					
(U)	MAJOR THRUST: Investigate and develop detailed six-degree-of-freedom and hardware-in-the-loop simulations 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.	4.200	4.568	5.400	5.629
(U)	In FY 2006: Completed development and establish a reusable, simulation architecture consisting of a set of reusable interoperable simulations to evaluate emerging munitions technologies. Completed developing an arbitrary waveform simulation using a commercial synthesizer chip. Improved 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)	In FY 2008: Continue refining the set of interoperable simulations, validating the reusable aspects, to evaluate emerging munitions technologies. Update and test multi-spectral phenomenology models and evaluate via synthetic scene simulation. Investigate laser radar (LADAR) scene generation to demonstrate a feasible projection system for hardware-in-the-loop testing.				

Exhibit R-2a, RDT&E Project Justification

BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602602F Conventional Munitions**	PROJECT NUMBER AND TITLE **2068 Advanced Guidance Technology**

DATE **February 2007**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Continue refining the set of interoperable simulations to evaluate emerging munitions technologies. Integrate and test updates for multi-spectral phenomenology models and evaluate updated results via synthetic scene simulation. Continue the investigation of a LADAR scene generation capability for hardware-in-the-loop testing.				
(U)					
(U)	CONGRESSIONAL ADD: Falcon Eye.	2.043	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Falcon Eye.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	18.554	17.889	17.891	18.015

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0603601F, Conventional Weapons Technology.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602602F Conventional Munitions**	PROJECT NUMBER AND TITLE **2502 Ordnance Technology**	

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2502 Ordnance Technology	39.458	43.979	39.913	38.066	40.341	40.302	40.538	42.096	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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.	7.024	6.700	7.810	8.800
(U) In FY 2006: Developed code enhancements to computer model for dynamic submunition dispensing of new weapon concepts. Developed a simplified finite element model to estimate damage to buildings caused by direct weapon effects. Improved 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) In FY 2008: Continue modeling damage to buildings caused by direct weapon effects. Develop capability to apply first principles computational tools to the design and evaluation of new munitions concepts. Identify high payoff technologies for defeating mobile targets.				
(U) In FY 2009: Continue modeling damage to buildings caused by direct weapon effects. Continue developing capability to apply first principles computational tools to design and evaluation of new munitions concepts. Continue to identify high payoff technologies for defeating mobile targets. Apply system level analysis tools to identify promising high payoff technologies for defeating mobile targets.				
(U)				
(U) MAJOR THRUST: Investigate and develop more efficient, affordable explosives including multi-phase blast explosives, cast and cure high energy composite explosives, and nano-scale metal fuels that	5.803	6.600	6.000	6.700

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions	PROJECT NUMBER AND TITLE 2502 Ordnance Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	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.				
(U)	In FY 2006: Developed highly energetic material with twice the power density of conventional explosives by developing and validating new energetics ignition parameters. Demonstrated use of multi-functional material or nano energetic fills. Fabricated cast/cure Plastic Bonded Explosives (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)	In FY 2008: Continue developing highly energetic material with twice the power density of conventional explosives by formulating advanced energetic materials. Evaluate the sensitivity and detonation performance and develop design processes for new energetic formulations. Characterize the chemical reaction kinetics of new energetic materials to develop a materials properties database.				
(U)	In FY 2009: Continue developing highly energetic material with twice the power density of conventional explosives by characterizing advanced explosive formulations. Evaluate the sensitivity and detonation performance and develop process of new energetic materials. Continue developing a materials properties database characterizing chemical reaction kinetics.				
(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.	7.300	7.050	5.600	6.000
(U)	In FY 2006: Demonstrated a high resolution, electromagnetic countermeasure-hardened, active imaging fuze that calculates warhead burst direction and detonation time. Developed a miniaturized fuze to provide safe and arm, burst point sensor, and low power initiator in a four cubic inch package. Developed a wireless communication system to fuze a hard target munition. Developed waveform agile				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602602F Conventional Munitions**	PROJECT NUMBER AND TITLE **2502 Ordnance Technology**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	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 munition. Continue to develop a waveform agile fuze to defeat smart jamming devices.				
(U)	In FY 2008: Test a miniaturized fuze to provide safe and arm, burst point sensor and low power initiator in a four cubic inch package. Complete static and sled testing of a wireless communication system to fuze a hard target munitions. Complete development of a waveform agile fuze to defeat smart jamming. Begin investigating novel warheads to initiate explosives.				
(U)	In FY 2009: Demonstrate a miniature fuze that provides safe and arm, burst point sensor and low power initiator in a four cubic inch package. Continue investigating novel methods to initiate explosives. Begin investigating miniature components to transmit bomb damage information.				
(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.	11.067	16.181	12.403	8.800
(U)	In FY 2006: Investigated precise time-of-arrival munitions. Identified critical technologies needed for an advanced next generation, low-cost miniature cruise missile. Investigated technologies to deny enemy operations through loitering, persistent, low-cost, multiple-shot munitions. Investigated nanotube-reinforced composites to reduce structural weight of weapons. Developed a miniaturized attack system to communicate target aim point position from behind enemy lines. Developed 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)	In FY 2008: Finish investigating technologies for miniature cruise missile development. Finish				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602602F Conventional Munitions**	PROJECT NUMBER AND TITLE **2502 Ordnance Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	miniaturizing the attack system to communicate target aim point position from behind enemy lines. Field test a covert video distribution capability to collect and transmit data to coordinate attack of enemy targets. Investigate reaction jet control technology to enable dual role air dominance missile technology. Begin to investigate the design of precision guided munitions.				
(U)	In FY 2009: Integrate new technology solutions into a covert video distribution capability and transmit data to coordinate attacks of enemy targets. Continue investigating reaction jet control for dual role area dominance missile technology. Continue investigating the design of precision guided munitions by performing subsystem design trade studies.				
(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.	8.264	7.448	8.100	7.766
(U)	In FY 2006: Demonstrated an ordnance package designed for low collateral damage and minimum far-field lethality. Completed in-house effort to improve penetrating warhead case survivability, depth of burial, and trajectory control with lower case thickness. Evaluated selected materials for high-speed penetrating weapons. Developed focusing kill mechanisms for dual role, dual range missiles. Investigated micro damage technologies to neutralize electronics with small robotic weapons.				
(U)	In FY 2007: Continue evaluating selected materials for high-speed penetrating weapons. Continue 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)	In FY 2008: Continue evaluating selected materials for high-speed penetrating weapons and the hard nose-caps against hard and combination targets. Begin investigating high strength next generation warhead cases with the eventual goal of terradynamic steering. Evaluate shaped charges to defeat medium and heavy armor. Continue investigating micro-damage technologies to neutralize electronics with small robotic weapons. Develop a small high velocity unmanned aerial vehicle (UAV) deliverable with strength to defeat hardened targets. Develop a submunition concept that can penetrate hardened target for agent defeat.				
(U)	In FY 2009: Complete evaluation of selected materials for high-speed penetrating weapons and the hard				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602602F Conventional Munitions**	PROJECT NUMBER AND TITLE **2502 Ordnance Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	nose-caps against hard and combination targets. Continue investigating high strength next generation warhead cases with the eventual goal of terradynamic steering. Continue evaluation of shaped charges to defeat medium and heavy armor. Continue investigating micro-damage technologies to neutralize electronics with small robotic weapons. Continue developing a small high velocity UAV deliverable with strength to defeat hardened targets. Continue investigating submunition technology that provide agent defeat mechanisms against hardened targets.				
(U)	Total Cost	39.458	43.979	39.913	38.066

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0603601F, Conventional Weapons Technology.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
02 Applied Research

PE NUMBER AND TITLE
0602605F DIRECTED ENERGY TECHNOLOGY

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	43.287	50.019	54.883	53.362	69.249	58.419	69.307	75.617	Continuing	TBD
4866	Lasers & Imaging Technology	28.795	25.124	33.584	31.954	42.985	35.715	42.897	47.041	Continuing	TBD
4867	Advanced Weapons & Survivability Technology	14.492	15.424	16.396	16.261	20.520	17.227	20.980	23.031	Continuing	TBD
55SP	Laser and Imaging Space Tech	0.000	9.471	4.903	5.147	5.744	5.477	5.430	5.545	0.000	0.000

Note: In FY 2008, relay mirror technology efforts in Project 55SP, Laser and Imaging Space Technology, will transfer to Project 4866, Lasers and Imaging Technology, within this PE in order to more effectively manage the efforts.

(U) A. Mission Description and Budget Item Justification

This program covers research in directed energy technologies, primarily lasers and high power microwaves. 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 2007, Congress added $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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	44.169	48.422	53.340	54.252
(U)	Current PBR/President's Budget	43.287	50.019	54.883	53.362
(U)	Total Adjustments	-0.882			
(U)	Congressional Program Reductions		-0.014		
	Congressional Rescissions		-0.189		
	Congressional Increases		4.300		
	Reprogrammings	-0.088	-2.500		
	SBIR/STTR Transfer	-0.794			

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics
Under Development.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602605F DIRECTED ENERGY TECHNOLOGY**	**4866 Lasers & Imaging Technology**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4866 Lasers & Imaging Technology	28.795	25.124	33.584	31.954	42.985	35.715	42.897	47.041	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2008, relay mirror technology efforts previously performed in Project 55SP, Lasers and Imaging Space Technology, within this PE will transfer to this project to more effectively manage the efforts.

(U) A. Mission Description and Budget Item Justification

This project explores the technical feasibility of moderate to high power lasers and supporting laser technologies for aircraft protection, force protection, precision engagement, and Global War On Terrorism missions. Develop new technologies, perform physics based modeling, and evaluate new materials that will enable development of: (1) compact, reliable, and affordable laser systems with good beam quality, scalability to high power, and high potential military utility; (2) optical and beam control systems to enhance laser beam propagation and pointing and tracking over long distances in the atmosphere. Emphasis will be on using computer modeling and simulation and laboratory experiments to demonstrate traceability to key concept performance parameters, reliability, affordability, and packaging requirements unique to potential applications. Develop and implement system concept assessment tools supporting the definition of laser system concept performance, military utility and cost trade decisions.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop solid state laser technologies for airborne tactical and strategic applications. Technologies include fiber lasers and bulk solid state lasers.	11.462	13.320	15.547	15.500
(U) In FY 2006: Developed laser component technologies for detecting, identifying, tracking, and defeating electro-optic targets from airborne tactical platforms. Enhanced new laser structures for near-infrared, mid-infrared, and long-wavelength operation. Developed single- and multi-wavelength packaging and delivery methods. Began development of solutions to aero-optical issues on airborne platforms. Assessed laser requirements for destroying detectors in the threat sensors. Performed lethality assessment studies of the various laser concepts in relevant scenarios. Validated vulnerability assessment models by experiments. Investigated and demonstrated alternative laser architectures and gain media. Demonstrated greater than five watts in a wavelength versatile laser. Refined laser technologies to obtain architectures that are favorable in terms of size, weight, efficiency, affordability, and fieldability for tactical laser weapon applications.				
(U) In FY 2007: Design and develop laser sources for jamming/damaging optical threats, focusing on increased efficiency and reliability. Perform testing of ultra-short pulse laser sources to evaluate potential applications. Continue development of solutions to aero-optical issues on airborne platforms. Investigate technologies for tactical platform disturbance mitigation and proceed to subsystem implementation of advanced techniques. Continue applying latest technologies to tactical laser handheld				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602605F DIRECTED ENERGY TECHNOLOGY**	PROJECT NUMBER AND TITLE **4866 Lasers & Imaging Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	systems. Perform additional lethality assessment studies of the various laser concepts in relevant scenarios. Continue to validate vulnerability assessment models. Refine technologies to obtain architectures that are favorable in terms of size, weight, efficiency, affordability, and fieldability for tactical laser weapon applications. Develop the most promising solid state laser technologies for scaling to the weapons class power level. Demonstrate "eye-safe" wavelength solid state laser technology for designator and illuminator applications.				
(U)	In FY 2008: Refine laser sources to obtain higher efficiencies and improve ruggedness of designs. Continue development of system-level solutions to aero-optical issues involving airborne tactical laser weapon applications. Perform further lethality assessment studies to assess the effectiveness of the various laser concepts in relevant scenarios. Continue coupon-level and mid-scale demonstration experiments to validate vulnerability assessment models. Continue to scale electric lasers up to the weapons class power level. Refine technologies in effort to obtain suitable parameters in terms of size, weight, efficiency, affordability, reliability, maintainability, supportability, environmental acceptability (air, land, and maritime), and ruggedness for the next-generation applications.				
(U)	In FY 2009: Improve design of laser sources for jamming/damaging optical threats. Perform damage tests against real or simulated advanced threat systems and use test results to verify models and laser effectiveness. Increase efficiencies and improve ruggedness of designs. Conclude development of system-level solutions to aero-optical issues of tactical laser weapons applications on airborne platforms, with goal of procurement of representative beam delivery sub-system. Continue lethality assessment studies to assess the effectiveness of the various laser concepts in relevant scenarios. Perform coupon-level and mid-scale demonstration experiments to validate vulnerability assessment models. Continue to scale electric lasers up to the weapons class power level.				
(U)					
(U)	MAJOR THRUST: Develop chemical, gas, and hybrid laser technologies (i.e. new fuel chemistry, fuel regeneration techniques, and nozzle designs) for scalable, high energy laser devices with improved efficiency for insertion into airborne platforms and ground based lasers.	4.673	4.885	6.074	5.470
(U)	In FY 2006: Continued to investigate the scalability of high performance zero-gravity singlet delta oxygen generator concepts for airborne laser applications. Demonstrated advanced chemical and electrical singlet oxygen generator technology to help improve current levels of performance. Investigated fiber pumped molecular gas lasers. Developed advanced diagnostics for chemical oxygen iodine laser performance measurements to identify potential enhancements. Began work on				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	technologies that would increase the range of future high power airborne lasers. Investigated 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 generators. Evaluate and refine advanced chemical laser technologies demonstrated in FY 2006. Pursue scaling chemical-electric hybrid laser technologies that offer potential for power scaling and component size and weight reduction.				
(U)	In FY 2008: Demonstrate enhanced-performance singlet delta oxygen generator coupled with advanced ejector nozzle concepts for airborne laser applications, including advanced fuel chemistries. Continue scaling path demonstrations for electric discharge oxygen-iodine lasers and diode-pumped atomic lasers.				
(U)	In FY 2009: Refine high-performance singlet delta oxygen generator and advanced ejector nozzle concepts for airborne laser applications based on results of previous demonstration. Begin real-world condition demonstrations for electric discharge oxygen-iodine lasers and diode-pumped atomic lasers.				
(U)					
(U)	MAJOR THRUST: Develop optical and imaging technologies for advanced beam control, atmospheric compensation, and pointing and tracking for future optical imaging/laser systems. Note: In FY 2008, relay mirror technology efforts previously performed in Project 55SP, Laser and Imaging Space Technology, within this PE were placed here to more effectively manage the efforts.	5.787	5.126	11.963	10.984
(U)	In FY 2006: Began development of component-level and system-level solutions to aero-optical issues involving tactical laser applications on airborne platforms; analyzed most promising concepts for field testing. Continued aero-optical wavefront sensor development. Evaluated advanced inertial reference unit improvements. Continued testing of tactical beam control propagation codes. Continued working towards demonstration of high-bandwidth active tracking of uncooperative targets. Simulated and investigated advanced adaptive optics for relay mirror uplink beam control. Developed and evaluated two beam propagation techniques for tracking and illumination of a cruise missile through an airborne relay mirror. Continued design of low-altitude relay mirror field experiments. Began testing of advanced sodium-beacon adaptive optics system on 3.5 meter telescope.				
(U)	In FY 2007: Continue development of system-level solutions to aero-optical issues involving tactical laser applications on airborne platforms and acquire adaptive optics system for wind tunnel aero-optics disturbance mitigation testing. Investigate technologies for tracking in clutter and tactical platform				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602605F DIRECTED ENERGY TECHNOLOGY**	PROJECT NUMBER AND TITLE **4866 Lasers & Imaging Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	disturbance mitigation. Develop selected technologies for transition from laboratory to field testing. Continue investigation of advanced adaptive optics techniques. Demonstrate detection and discrimination of small, nonresolved space objects using sodium-beacon adaptive optics system.				
(U)	In FY 2008: Integrate adaptive optics hardware in wind tunnel tests to measure and characterize aero-optical disturbances. Develop and analyze advanced tactical beam control architectures and critical beam control components, such as inertial references and trackers. Begin development of lightweight optics and advanced tracking techniques and technologies. Complete sub-system fabrication in order to conduct a low-power demonstration. Begin development of a 25 kilowatt laser for integration into the relay mirror system. Begin integration of sodium beacon with high efficiency adaptive optics system.				
(U)	In FY 2009: Complete demonstration of system-level solutions to aero-optical distortions associated with airborne tactical laser weapons systems in wind-tunnel environment. Implement advanced platform disturbance initiative-readied technologies as component of end-to-end field demonstration of precision laser control. Continue further concept lethality assessments. Provide system concept engineering support for an integrated ground tactical demonstration. Demonstrate closed loop tracking in conjunction with sensor systems as part of continued development and integration of the relay mirror breadboard system. Demonstrate compensated imaging and detection of very dim space objects at visible wavelengths. Integrate and demonstrate advanced tactical beam control systems and critical beam control components, such as inertial references and trackers. Continue development of lightweight optics and advanced tracking techniques and technologies. Conduct a low-power demonstration. Integrate a 25 kilowatt laser with the relay mirror to demonstrate the laser-mirror system. Integrate sodium beacon with high efficiency adaptive optics system.				
(U)					
(U)	CONGRESSIONAL ADD: Adaptive Optics Lasercom	2.421	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Adaptive Optics Lasercom.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Laser Materials Development	2.710	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Advanced Laser Materials Development.				
(U)	In FY 2007: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602605F DIRECTED ENERGY TECHNOLOGY**	PROJECT NUMBER AND TITLE **4866 Lasers & Imaging Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Ceramics for Next Generation Tactical Laser Systems	1.742	1.793	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Ceramics for Next Generation Tactical Laser Systems.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Ceramics for Next Generation Tactical Laser Systems.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	28.795	25.124	33.584	31.954

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0601108F, High Energy 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										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 Advanced Technology Program.

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

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602605F DIRECTED ENERGY TECHNOLOGY**	**4867 Advanced Weapons & Survivability Technology**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4867	Advanced Weapons & Survivability Technology	14.492	15.424	16.396	16.261	20.520	17.227	20.980	23.031	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Investigate and develop technologies for narrowband and wideband HPM components to support multiple Air Force applications such as the disruption of electronic systems and subsystems.	6.417	4.015	4.821	4.445

(U) In FY 2006: Developed a compact repetitively pulsed gigawatt-class HPM source. Developed a conformal high power phased array antenna for the compact pulsed HPM source. Developed compact permanent magnets for the compact pulsed gigawatt HPM source. Developed a compact pulse power system to drive the HPM source. Conducted laboratory measurements of the compact pulsed gigawatt HPM demonstration unit. Developed vacuum systems that are compact and can be installed in an airborne platform. Developed compact solid-state wideband source and antenna for target identification. Developed target identification algorithms. Conducted target identification field experiments to determine optimal design.

(U) In FY 2007: Conduct measurements using the compact repetitively pulsed gigawatt-class HPM demonstration unit. 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 a mesoband unit 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 target under trees.

(U) In FY 2008: Continue testing of the compact repetitively pulsed gigawatt-class HPM demonstration unit. Continue to improve the compact HPM source and conformal antenna such that they can be

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	integrated into an airborne platform. Develop a compact wideband target identification unit that can be used to conduct laboratory experiments in support of the target under trees program. Further develop flux trapping technology for compact flux compression generators and perform functional testing. Perform design studies for disk generators to further reduce the size of single shot devices. Perform functional testing of a multi-stage ceramic loaded polymer Blumlein line.				
(U)	In FY 2009: Enhance the compact repetitively pulsed gigawatt-class HPM testbed. Integrate and demonstrate the conformal antenna and command and control system for the compact HPM testbed. Improve the wideband antenna and high voltage switch and demonstrate the effectiveness during field tests.				
(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. Develop and apply sophisticated models to enhance the development of HPM and related technology.	3.925	4.478	5.315	5.607
(U)	In FY 2006: Continued to advance elemental modeling methodology to predict target susceptibility. Developed advanced descriptions of target functional behavior for insertion into modeling and simulation codes. Continued susceptibility testing of electronic targets. Validated plasma model on dielectric pulse power interfaces and antenna breakdown. Improved the fidelity of the solution to electromagnetic models by statically refining the numerical grid and by having a boundary conformal solution. Continued integration of electromagnetic codes with thermal and electron transport codes.				
(U)	In FY 2007: Predict susceptibilities of relevant electronic systems based on model and manufacturer. Conduct further experiments on the systems to verify model accuracy and compare predictions with experiments. Adjust models as required. Identify and mitigate platform susceptibility to onboard HPM and associated electromagnetic interference/compatibility considerations for fratricide issues. Refine preliminary battle damage assessment system for HPM sources. Continue susceptibility testing of electronic targets. Apply hardening techniques to identified platforms. Identify and mitigate HPM susceptibility for military systems against both domestic and foreign sources. Validate integration of electromagnetic codes with thermal and electron transport codes for HPM sources and components. Begin integration of boundary conformal solutions. Apply plasma model for high field regions. Investigate improved material physics models. Initiate development of automatic optimization for HPM system design.				
(U)	In FY 2008: Incorporate elemental modeling into predictive code for use in targeting and war gaming.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	Continue susceptibility testing of electronic targets. Apply hardening techniques and technology to identified platforms. Identify and mitigate HPM susceptibility for military systems of interest to HPM sources. Continue to refine preliminary battle damage assessment technologies for use with HPM. Apply virtual modeling for HPM system enhancement. Validate and document the efficacy of automatic adaptive grid generation for HPM system design. Extend the air breakdown model already in development to simulate plasma channel formation. Apply boundary conformal methods to HPM system enhancement. Continue to investigate and integrate improved material models into HPM tube simulations. Continue development of automatic design enhancement.				
(U)	in FY 2009: Continue susceptibility testing of electronic targets to refine modeling techniques. Update and enhance modeling and simulation software to account for new developments. Continue platform susceptibility work and apply hardening technology to platforms. Continue application of virtual modeling for HPM system enhancement. Begin integration of adaptive grid generation methods into HPM system simulations. Using boundary conformal methods to perform HPM system enhancement. Apply improved material physics models to HPM system enhancement. Apply automatic enhancement to HPM tube design.				
(U)					
(U)	MAJOR THRUST: Investigate HPM technologies that support offensive and force protection airborne tactical applications, including non-lethal counterpersonnel applications, made possible by the increased power available on future aircraft.	4.150	6.931	6.260	6.209
(U)	In FY 2006: Refined HPM system source code to reflect payload to platform integration issues such as thermal, x-ray, and electrical issues. Examined the status of power conditioning subsystems to determine their applicability to an airborne experiment. Ensured understanding of air breakdown potentials given specific antenna interfaces. Continued refinement of solid state subsystem designs. Continued refinement of solid state pulsed power subsystem designs.				
(U)	In FY 2007: Further develop HPM source materials and assess applicability of solid state subsystem designs supporting ruggedized high power airborne and counter-improvised explosive device systems. 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. 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	(effects, safety, stabilization, engagement) requirements impacting overall airborne conceptual approach, including non-lethal. Refine millimeter wave diagnostic techniques.				
(U)	In FY 2008: Continue development of HPM source materials and assess applicability of solid state subsystem designs supporting ruggedized high power airborne and counter-improvised explosive device systems. Analyze the results from the HPM system source code that reflects multiple options for high power subsystem components. Continue to refine antenna concepts to meet airborne requirements for counter electronics and counter-improvised explosive device systems including addressing issues related to propagation, breakdown, and radomes. Continue development of full power non-lethal test source and technology studies for conceptual approach. Complete millimeter wave diagnostic techniques.				
(U)	In FY 2009: Implement maturing HPM source materials and assess the applicability of solid state subsystem designs supporting ruggedized high power airborne and counter-improvised explosive device systems. Implement the enhanced options for high power subsystem components based on the results of the HPM system source code. Implement the antenna design that best meets airborne requirements for counter electronics and counter-improvised explosive device systems including addressing issues related to propagation, breakdown, and radomes. Complete development of full power non-lethal test source. Continue non-lethal beam control/antenna work and technology studies for conceptual approach.				
(U)	Total Cost	14.492	15.424	16.396	16.261

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602202F, Human Systems Technology.										
(U) PE 0603605F, Advanced Weapons Technology.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602605F DIRECTED ENERGY TECHNOLOGY**	PROJECT NUMBER AND TITLE **4867 Advanced Weapons & Survivability Technology**

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602605F DIRECTED ENERGY TECHNOLOGY**	**55SP Laser and Imaging Space Tech**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
55SP Laser and Imaging Space Tech	0.000	9.471	4.903	5.147	5.744	5.477	5.430	5.545	0.000	0.000
Quantity of RDT&E Articles	0	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. Also in FY 2008, relay mirror technology efforts previously will transfer from this project to Project 4866, Lasers and Imaging Technology, to this project to more effectively manage 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 future space-object imaging systems. Assess the vulnerability of satellites to the effects of high-energy laser weapons and update catalogued satellites.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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 future space-object imaging systems. Note: In FY 2008, relay mirror technology efforts previously performed in this major thrust will be moved to Project 4866, Lasers and Imaging Technology, within this PE to more effectively manage the efforts.	0.000	7.613	2.692	2.824

(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. Continue investigation of advanced adaptive optics techniques for uplink beam control. Investigate designs for tactical relay mirrors for propagation of laser energy through turbulence. Begin procurement of long lead optical components to include transmitting and receiving beam director telescopes for integration into a breadboard relay mirror payload. Perform phased array imaging experiment in the presence of atmospheric disturbances without the aid of a retro-reflector. Perform orbit angular validation momentum experiment and establish a research approach to advance a concept for secure high bandwidth communications. Conclude the development of lightweight mirrors.

(U) In FY 2008: Understand the bandwidth, movement, and resolution limits of various adaptive optics concepts, correlate the attributes to user needs to include aero-optic compensation, and demonstrate a selected concept in a system level experiment. Complete a low power phased array transceiver experiment that includes simultaneous imaging and beam projection with wide field of regard beam steering elements. Select a particular approach to enable orbital angular momentum communication and

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602605F DIRECTED ENERGY TECHNOLOGY**	PROJECT NUMBER AND TITLE **55SP Laser and Imaging Space Tech**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	began experimental validation with continued modeling and theoretical investigation.				
(U)	In FY 2009: Develop advanced adaptive optic components and evaluate system implementation of those components. Continue to work on the orbital angular momentum communication research.				
(U)					
(U)	MAJOR THRUST: Assess the vulnerability of satellites to the effects of high-energy laser weapons and update catalogued satellites.	0.000	1.858	2.211	2.323
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop and apply new, improved algorithms and hardware for satellite characterization and vulnerability assessment. Continue to update assessment methodology by incorporating new data, including results of laser illumination, tracking, and compensated imaging, techniques. 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 continue to provide data to U.S. Strategic Command for the performance of Laser Clearinghouse functions. Continue to expand knowledge of space material properties and aging effects. Continue to improve and mature capabilities to rapidly fuse sensor data to ascertain the health and status of aerospace systems.				
(U)	In FY 2008: Explore new methods to develop and apply improved algorithms and hardware for satellite characterization and assessment. Continue to refine assessment methodology by incorporating new data into modeling tools, including results of laser illumination, tracking, and compensated imaging; and applying new techniques. Assess the survivability and vulnerability of evolving aerospace systems to the effects of directed energy weapons. Integrate developed space material properties and aging effects data and algorithms into assessments. Continue to improve and mature capabilities to rapidly fuse existing sensor data to assess the operational health and status of aerospace systems while working to begin transition of these capabilities to U.S. Strategic Command and other users.				
(U)	In FY 2009: Expand analysis capabilities to provide assessments of effects on aerospace systems from new and emerging directed energy concepts. Continue to refine and broaden assessment methodologies by incorporating new experimental data from laser illumination, tracking, and compensated imaging; results of space materials properties and aging analysis; and enhanced numerical techniques. Continue to assess the survivability and vulnerability of evolving aerospace systems to the effects of directed energy weapons. Continue to advance the capabilities to rapidly fuse sensor data to assess the operational health and status of aerospace systems and continue to transition the matured capabilities to operational users.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602605F DIRECTED ENERGY TECHNOLOGY**	PROJECT NUMBER AND TITLE **55SP Laser and Imaging Space Tech**

	FY 2006	FY 2007	FY 2008	FY 2009
(U) B. Accomplishments/Planned Program ($ in Millions)				
(U) Total Cost	0.000	9.471	4.903	5.147

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize the efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

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Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
02 Applied Research

PE NUMBER AND TITLE
0602702F Command Control and Communications

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	95.676	128.680	116.705	105.496	128.069	111.838	115.121	119.628	Continuing	TBD
4519	Communications Technology	23.987	29.273	27.458	27.126	35.448	24.788	29.305	31.385	Continuing	TBD
4594	Information Technology	26.879	33.581	32.154	31.691	33.502	31.544	33.735	34.979	Continuing	TBD
5581	Command and Control (C2) Technology	44.810	49.696	39.876	35.584	49.132	45.263	42.076	43.071	Continuing	TBD
66SP	Space Optical Network Tech	0.000	16.130	17.217	11.095	9.987	10.243	10.005	10.193	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 and effectiveness by providing the right information, at the right time, in the right format, anytime, anywhere in the world. The program has four projects. The Communication Technology project develops assured and secure communications technology, and the capability to attack and exploit adversarial information and information systems. The Information Technology project develops improved and automated capabilities to generate, process, fuse, exploit, interpret, and disseminate timely and accurate information. 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 complex, compressed time scales required for tomorrow's conflicts. The Space Optical Networking Technology 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. Note: In FY 2007, Congress added $2.5 million for Adaptive Optics for Lasercom System, $1.0 million for Advanced Collaboration Platform for Net Centric Command and Control (C2), $1.5 million for MASINT Visualization Tools, $1.1 million for Massively Parallel Optical Interconnects, $2.2 million for Space Qualified Command Data Link, and $1.6 million for Digital Free Space Optical Laser Transmitter Modems. This program is 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 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications

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

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	96.714	119.267	118.562	116.126
(U)	Current PBR/President's Budget	95.676	128.680	116.705	105.496
(U)	Total Adjustments	-1.038			
(U)	Congressional Program Reductions				
	Congressional Rescissions	-0.003	-0.487		
	Congressional Increases		4.100		
	Reprogrammings	-0.409	5.800		
	SBIR/STTR Transfer	-0.626			

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602702F Command Control and Communications**	**4519 Communications Technology**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4519 Communications Technology	23.987	29.273	27.458	27.126	35.448	24.788	29.305	31.385	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

The Air Force requires technologies that enable assured, worldwide/theater, high capacity, communications and networking for Air Force Task Forces. These communication and networking technologies will provide capabilities for en route and deployed distributed collaborative command, control, surveillance, reconnaissance and exploitation. A rapidly deployed force 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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop assured and survivable information and networking technologies enabling worldwide command, control, surveillance, reconnaissance and exploitation operations for the Air Force.	9.763	12.072	9.749	9.073
(U) In FY 2006: Completed development of technologies to improve quality of service and survivability for globally distributed information systems (e.g., JBI). Completed development of programmable networking algorithms that enable wide area dynamic creation of advanced information delivery services, independent of the underlying physical infrastructure devices. Developed capabilities for self-organizing, self-healing, autonomous networking. Developed policy-based network management technologies for real-time network response to changes in information condition (INFOCON) levels. Developed 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. Developed content-based delivery networking (CBDN) technologies for intelligent network delivery and 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

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) In FY 2008: Continue development of policy-based network management technologies for real-time network response to changes in INFOCON levels. Continue development of airborne CBDN, synergistic with the Joint Tactical Radio System Wideband Networking Waveform's Network Service Layer, and apply to extremely dynamic airborne nets. Continue design and development of airborne network modeling and simulation technology. Initiate design and development of cognitive networking technology that senses operating environment, learns application requirements, and intelligently adapts network protocols. Initiate design and development of network operations and security capability to provide policy-based, mission-based, cross-domain, heterogeneous network quality of performance, security, configuration and fault management in a net-centric environment. Develop and complete intelligent network management agents designed to monitor the airborne domain's handling of the flow of information from platform to platform through various interconnected communication nodes and links. Initiate development of a resilient and self-regenerating information Network Centric Warfare enterprise that dynamically recognizes, characterizes and understands novel cyber attacks and service anomalies, aids in the creation of synthetically diverse, functionally equivalent software, and continuously monitors, reconfigures, and self optimizes the mission critical enterprise to resist new attacks.

(U) In FY 2009: Complete development of airborne CBDN, synergistic with the Joint Tactical Radio System Wideband Networking Waveform's Network Service Layer, and apply to extremely dynamic airborne nets. Continue design and development of airborne network modeling and simulation technology. Continue design and development of cognitive networking technology that senses operating environment, learns application requirements and adapts network protocols. Complete development of policy-based network management technologies for real-time network response to changes in INFOCON levels. Continue design and development of network operations and security capability to provide policy based, mission based, cross domain, heterogeneous network quality of performance, security, configuration and fault management. Initiate development of small hand-held multi-data rate , IP compatible, covert network radios. Continue development of a resilient and self-regenerating information Network Centric Warfare enterprise that Dynamically recognizes, characterizes and understands novel cyber attacks and service anomalies, aids in the creation of synthetically diverse, functionally equivalent software, and Continuously monitors, reconfigures, and self optimizes the

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	mission critical enterprise to resist new attacks Initiate development of secure data sharing to prevent the disclosure of sensitive information to untrustworthy users				
(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.	4.484	4.705	4.359	3.731
(U)	In FY 2006: Developed 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. Developed 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. Completed development of higher performance video compression and modulation techniques that enable critical objectives for high bandwidth information transmission and exploitation capabilities over wireless channels. Designed and developed 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 [assured] voice, data, and video communications. Performed such design and development within the framework of the Joint Tactical Radio System or compatible software defined radios. Explored/exploited 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	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)	In FY 2008: Complete demonstration of adaptively combined multi-dimensional (space, time, frequency, coding, polarization) transmission techniques that enable high bandwidth information transmission and exploitation capabilities. Complete demonstration of multi-mode, multi-function, sense-and-adapt air-mobile communications capability to dynamically alter communications methods under fast-changing environment. Continue development of quantum key distribution and cryptography technologies to effect ultra-secure communications for wired and wireless networks. Initiate design and demonstration of assure access, anti jam communications capability that combines multi-dimensional (space, time, frequency, coding, polarization) transmission techniques, multi frequency, multi wavelength, multi path techniques and spectrum sense and adapt techniques. Initiate investigation to provide assured access (anti-jam) covert high capacity spectrum dominance for global networking while denying the adversary the same. Initiate development of scaleable video compression schemes which dynamically trade-off bandwidth and quality based upon the priority of the required information. Initiate the development of advanced, automated, network and bandwidth management technologies to move, manage, and process information in real-time for the warfighter.				
(U)	In FY 2009: Complete development of quantum key distribution and cryptography technologies to effect ultra-secure communications for wired and wireless networks. Continue design and demonstration of assure access, anti jam communications capability that combines multi-dimensional (space, time, frequency, coding, polarization) transmission techniques, multi-frequency, multi-wavelength, multi-path techniques, and spectrum sense and adapt techniques. Continue the development of advanced, automated, network and bandwidth management technologies to move, manage, and process information in real-time for the warfighter.				
(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.	1.796	2.130	1.500	1.000
(U)	In FY 2006: Explored techniques for tunable, high power radio frequency filtering to reduce overall radio frequency component equipment size, weight, and signal losses. Developed, tested, and assessed exploratory radio frequency and optical information transfer technologies.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602702F Command Control and Communications**	PROJECT NUMBER AND TITLE **4519 Communications Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2007: 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)	In FY 2008: Complete development, test, and assessment of exploratory radio frequency and optical information transfer technologies. 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 applicable to battlefield network operations.				
(U)	In FY 2009: 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 applicable to battlefield network operations.				
(U)					
(U)	MAJOR THRUST/CONGRESSIONAL 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. Note: Increase in funding in FY 2008 and FY 2009 is due to emphasis on offensive cyber operations.	7.944	7.866	11.850	13.322
(U)	In FY 2006: Developed intrusion detection techniques for wireless networks. Developed automated capabilities for damage assessment and recovery. Developed techniques for defining defensive courses-of-action to counter adversary information warfare attacks. Developed defensive techniques for wireless, mobile and embedded systems. Developed detection and eradication techniques for malicious code. Developed of active response and computer network attack (CNA) technologies. Developed advanced correlation fusion techniques for defensive course of action analysis. Initiated work addressing self-healing systems. Conducted 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.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602702F Command Control and Communications**	PROJECT NUMBER AND TITLE **4519 Communications Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Complete development of techniques for defining rapid defensive courses-of-action (COA) to counter adversary information warfare attacks. Continue to develop defensive techniques for wireless, mobile and embedded systems. Demonstrate detection and eradication techniques for malicious code. Complete development of advanced correlation fusion techniques for defensive course of action analysis. Complete efforts in self-healing systems. Initiate assured end-to-end Quality of Service (QoS) and Quality of Assurance (QoA) integration to the informaton system enterprise during malicious and non-malicious faults. Develop a prototype that will be able to model the unique aspects of an IP-based airborne network (e.g., aircraft communications, antennas, and networking components) against a variety of cyber threats with the end-goal of improving the overall defenses of the airborne network. Initiate development of access techniques allowing "cyber paths" to protected adversary information systems through a multiplicity of attack vectors. Initiate development of stealth and persistence technologies enabling continued operation within the adversary information network. Initiate programs to provide the capability to exfiltrate any and all types of information from compromised information systems enabling cyber intelligence gathering to achieve cyber awareness and understanding. Initiate technology programs to deliver D5 (deny, degrade, destroy, disrupt, and deceive) effects to the adversary information systems enabling integrated and synchronized cyber and traditional kinetic operations.				
(U)	In FY 2009: Initiate work in Cyber Command and Control for defensive cyber operations to achieve cyber awareness and understanding. Continue to develop defensive techniques for wireless, mobile and embedded systems. Continue assured end-to-end Quality of Service (QoS) and Quality of Assurance (QoA) integration to the informaiton system enterprise dueing malicious and non-malicious faults. Initiate work in autonomic defensive response to rapidly recover from adversary cyber attacks. Continue development of information system access methods. Initiate efforts to propagate through adversary networks. Continue cyber intelligence gathering efforts to achieve cyber situational awareness and understanding. Continue cyber and traditional kinetic weapon integration technology development and initiate efforts for cyber delivery to influence operations effects.				
(U)					
(U)	CONGRESSIONAL ADD: Adaptive Optics Lasercom System	0.000	2.500	0.000	0.000
(U)	In FY2006: Not Applicable				
(U)	In FY2007: Develop and demonstrate reliable bi-directional ground and/or airborne lasercom communications link that automatically acquires and maintains itself in a seamless operation.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602702F Command Control and Communications**	PROJECT NUMBER AND TITLE **4519 Communications Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY2008: Not Applicable				
(U)	In FY2009: Not Applicable				
(U)					
(U)	Total Cost	23.987	29.273	27.458	27.126

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0603789F, C3I Advanced Development.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602702F Command Control and Communications**	**4594 Information Technology**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4594 Information Technology	26.879	33.581	32.154	31.691	33.502	31.544	33.735	34.979	Continuing	TBD
Quantity of RDT&E Articles	0	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, assessment and execution cycles 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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop innovative multi-sensor collaborative fusion technologies in a fully distributed air and space environment.	6.270	7.646	7.062	6.386

(U) In FY 2006: Developed and evaluated fusion techniques for optimal fusion management. Tested and analyzed vehicle motion models for variable state multiple algorithm to associate the current location of vehicle with a future state. Enhanced multi-source fusion techniques for probabilistic identification and continuous tracking of military significant threats in the battlespace. Evaluated evidence accrual and data mining techniques for improved fusion performance. Developed 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 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) In FY 2008: Evaluate fusion management and advance the state-of-the-art in track-to-track fusion

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

techniques. Continue the process of probabilistic identification though the use of multi-source fusion. Continue to increase probabilistic confidence through the inclusion of higher-level fusion techniques in the situational assessment and process refinement area. Continue to develop techniques to dynamically update advanced reasoning fusion engines to adapt to changing threat conditions. Continue to 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. Develop new track algorithms that combine traditional kinematic associations with multi-INT reasoning to improve the identification and track life times of ground moving targets; taking into account the limitations of gap times, dense target environments and large sensor data inaccuracies. Develop a set of algorithms that can automatically develop, reason, dynamically update various sub-sets of the existing intelligence preparation of the battlespace products (e.g., named areas, target areas, COA, units, infrastructure areas, lines of communication). Initiate development of fused air, ground, and space information through machine-to-machine automatic fusion and dynamic re-tasking processes resulting in a single network centric operational picture. Processes to be examined include machine-to-machine automated multi-INT fusion, long term automated tracking and ID of nominated targets, and automated/adaptive pattern recognition. Initiate investigation of Fusion of CybINT (Cyber Intelligence) with traditional INTs.

(U) In FY 2009: Evaluate fusion management and advance the state-of-the-art in track-to-track fusion techniques. Complete the process of probabilistic identification though the use of multi-source fusion. Continue to increase probabilistic confidence through the inclusion of higher-level fusion techniques in the situational assessment and process refinement area. Complete the development of techniques to dynamically update advanced reasoning fusion engines to adapt to changing threat conditions. Complete the development and assessment of intelligence, surveillance, and reconnaissance management techniques that optimize the fusion process for identification and continuous tracking of military significant threats. Complete the development and assessment of network centric approaches to provide distributed fusion techniques to the warfighter. Continue the development of new track algorithms that combine traditional kinematic associations with multi-INT reasoning to improve the identification and track life times of ground moving targets; taking into account the limitations of gap times, dense target environments and large sensor data inaccuracies. Complete the development of a set of algorithms that can automatically develop, reason, dynamically update various sub-sets of the existing intelligence preparation of the battlespace products (e.g., named areas, target areas, COA, units,

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	infrastructure areas, lines of communication). Continue development of fused air, ground, and space information through machine-to-machine automatic fusion and dynamic re-tasking processes resulting in a single network centric operational picture. Processes to be examined include machine-to-machine automated multi-INT fusion, long term automated tracking and ID of nominated targets, and automated/adaptive pattern recognition. Continue investigation of Fusion of CybINT with traditional INTs.				
(U)					
(U)	MAJOR THRUST: Develop higher-level fusion and the enabling information/knowledge base technologies to achieve situational awareness and understanding at all command levels for the dynamic planning, assessment and execution processes.	5.503	6.745	7.319	8.668
(U)	In FY 2006: Completed development of intermediate information extraction techniques to decrease analysis time for decision-making and enabling the ability to populate knowledge base systems. Completed 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. Developed interactive contextual reasoning with inference techniques for self-organizing data repositories, and content-based extraction to support identification of potential events in the world. Enhanced 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. Developed 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)	In FY 2008: Complete enhancement of 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 awareness and understanding. Continue				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602702F Command Control and Communications**	PROJECT NUMBER AND TITLE **4594 Information Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	developing inferencing techniques for reasoning about the situation and for predicting adversarial intent and threat possibility. Develop a dynamic real-time information management capability with the objective of decreasing the execution speeds of embedded HPC and enterprise infospheres by 100X. Initiate development of multi-source and automated recognition techniques to support analysis of current situations. Initiate development of technology demonstration plans for cyber situational awareness and understanding using an autonomous set of cooperative agents under positive control to defend mission critical Air force (AF) assets. Initiate development of technology demonstration plans for active intelligence, surveillance and reconniassance (ISR) defense on wired networks to perform an adaptive response to multiple, coordinated, sustained attacks. Initiate research to forecast actionable futures to support a decision maker's ability to appraise and plan the "best" blue course of action for Rapid, Decide, Act and Adapt. Initiate research to achieve the capability to analyze multiple courses of action (COA) having cascading effects in near real-time. The capability will be able to mix kinetic and non-kinetic options, continuously forecast the direct and indirect effects of each COA, and play COAs forward in time to identify key plan dependencies, decision points, and the foreclosure of options.				
(U)	In FY 2009: Complete 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 awareness and understanding. Continue developing inferencing techniques for reasoning about the situation and for predicting enemy intent and threat possibility. Continue development of multi-source and automated recognition techniques to support analysis of current situations. Continue development of technology demonstration plans for cyber situational awareness and understanding using an autonomous set of cooperative agents under positive control to defend mission critical AF assets. Initiate development of technology demonstration plans for active ISR defense on wired networks to perform an adaptive response to multiple, coordinated, sustained attacks. Continue research to achieve the capability to analyze multiple courses of action (COA) having cascading effects in near real-time. The capability will be able to mix kinetic and non-kinetic options, continuously forecast the direct and indirect effects of each COA, and play COAs forward in time to identify key plan dependencies, decision points, and the foreclosure of options. Continue research to forecast actionable futures to support a decision maker's ability to appraise and plan the "best" blue course of action for Rapid, Decide, Act and Adapt.				
(U)					
(U)	MAJOR THRUST: Develop automatic and dynamically reconfigurable, affordable, scalable, distributed	4.041	4.770	6.273	7.068

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

petaflop processing technologies for real-time C2 global information systems.

(U) In FY 2006: Completed architecture for support of real-time requirements for dominant battlespace awareness. Completed study results of next generation information technologies for C2 systems. Evaluated architectural features for cognitive information processing. Initiated algorithm development for next generation information technologies for C2 systems. Initiated architectural development for cognitive information processing. Developed and characterized 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) In FY 2008: Initiate implementation of architectural features for cognitive information processing. Continue algorithm development for next generation information technologies for C2 systems. Continue development and characterization of high performance computers for quantum computing applications. Continue development and characterization of the next generation of high performance computers. Develop a prototype chip that contains a hybrid architecture design; which will provide an emulation capability for large scale cognitive architecture evaluations. Initiate the development of the tools, techniques, standards and technologies required to build highly complex software-intensive systems.

(U) In FY 2009: Continue implementation of architectural features for cognitive information processing. Complete algorithm development for next generation information technologies for C2 systems. Complete architectural development for cognitive information processing. Complete development and characterization of high performance computers for quantum computing applications. Continue development and characterization of the next generation of high performance computers. Complete the development of a prototype chip that contains a hybrid architecture design; which will provide an emulation capability for large scale cognitive architecture evaluations. Continue the development of the tools, techniques, standards and technologies required to build highly complex software-intensive systems. Initiate development of high capacity processing on demand which will reduce the ever increasing amounts of raw data to actionable information. Provide hardware and system/support software that enables complex software to be readily composed.

(U)

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602702F Command Control and Communications**	PROJECT NUMBER AND TITLE **4594 Information Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	MAJOR THRUST: Develop modeling and simulation technologies for the next generation of planning, assessment, and execution environments.	2.426	2.776	2.793	2.579
(U)	In FY 2006: Developed advanced modeling and simulation technologies to support next generation planning execution and assessment environments. Developed adversarial behavior models and modeling techniques for dynamic course of action assessment and prediction. Initiated investigation of techniques for integrated interaction and assessment of friendly versus enemy courses of action. Developed 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.				
(U)	In FY 2008: Complete demonstrations of advanced modeling and simulation technologies to support next generation planning, assessment and execution environments. Continue to demonstrate adversarial behavior models and modeling techniques for courses of action (COA) assessment and prediction. Continue to conduct concept demonstrations of integrated interaction and assessment of friendly versus adversary courses of action. Continue to demonstrate a prototypical dynamic situation assessment and prediction system. Continue to investigate advanced concepts to provide approaches for a modeling toolset that enables the warfighter to build composable simulations. Initiate investigation of ability to forecast potential adversaries and events based on indications of known evidence and projected known and/or anticipated threat(s).				
(U)	In FY 2009: Complete demonstrations of adversarial behavior models and modeling techniques for courses of action assessment and prediction. Continue to conduct concept demonstrations of integrated interaction and assessment of friendly versus adversary courses of action. Complete demonstration of a prototypical dynamic situation assessment and prediction system. Continue to investigate advanced concepts to provide approaches for a modeling toolset that enables the warfighter to build composable simulations. Continue investigation of ability to forecast potential adversaries and events based on indications of known evidence and projected known and/or anticipated threat(s).				
(U)					
(U)	MAJOR THRUST: Develop real-time embedded information system technologies for complex,	1.978	2.210	2.700	1.962

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

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.

(U) In FY 2006: Developed dynamically reconfigurable aerospace systems using adaptive computing techniques to support image/video processing and data compression. Developed 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. Developed processes, methods, and techniques to provide assured performance, integrity, and security of real-time embedded information systems. Developed algorithms, methods, and processes to support real-time, adaptive resource management of system resources across multiple tactical platforms. Developed multi-level secure middleware for real-time embedded system architectures. Developed methods of computation and computing processes using biologically-inspired and biologically-based computation for embedded systems application. Initiated 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) In FY 2008: Continue development of dynamically reconfigurable aerospace systems using adaptive computing techniques to support image/video processing and data compression. Continue development of affordable, high assurance architecture components for real-time embedded systems supporting Multi-Level Security/Multiple Single Levels of Security (MLS/MSLS) and mixed criticality. Continue

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	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 2009: Continue development of dynamically reconfigurable aerospace systems using adaptive computing techniques to support image/video processing and data compression. Continue development of affordable, high assurance components for real-time embedded systems supporting Multi-Level Security/Multiple Single Levels of Security (MLS/MSLS) and mixed criticality. 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)					
(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 Add funding of $1.5 million in FY 2007.	6.661	9.434	6.007	5.028
(U)	In FY 2006: Developed tools to increase the production capability of the intelligence analyst. Develop techniques in steganography, steganalysis, watermarking, and digital data forensics for imagery, video, and speech information protection and authentication, intelligence exploitation, and analysts' tool aids. Developed 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, including the development of MASINT capability which integrates inputs from various sensors and visually display the critical MASINT information. Conduct Congressionally directed effort for MASINT visualization tools.				
(U)	In FY 2008: Continue the development of the multi- intelligence toolsets for the processing, exploitation and dissemination of actionable intelligence. Develop more effective multi-sensor signature exploitation algorithms to enhance detection (by 50%), identification (by 25%), and assessment (10X reduction in analyst time) of difficult targets; taking into account the complementary signature features				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	(e.g., geo-physical, materials) that can be derived from multiple MASINT sensors. Develop algorithms to automatically detect and identify audio protection and channelization effects in modern modulated personal communications systems (PCS) with the goal of providing analysts the capability to automatically detect speech privacy and identify methods and means used.				
(U)	In FY 2009: Continue the development of the multi- intelligence the processing, exploitation and dissemination of actionable intelligence. Complete the development of more effective multi-sensor signature exploitation algorithms to enhance detection (by 50%), identification (by 25%), and assessment (10X reduction in analyst time) of difficult targets; taking into account the complementary signature features (e.g., geo-physical, materials) that can be derived from multiple MASINT sensors. Complete the development to automatically detect and identify audio protection and channelization effects in modern modulated personal communications systems with the goal of providing analysts the capability to automatically detect speech privacy and identify methods and means used. Initiate development of methods and mechanisms to achieve robust/tamper-proof self-authenticating, self-regenerating code/data and detection and eradication systems for polymorphic malware. Research will include the detection and prevention of embedded malicous software (malware), system self-optimization / diagnosis / recovery, and the development of self-correcting watermarked code and data for trusted and optimized computing.				
(U)	Total Cost	26.879	33.581	32.154	31.691

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0603789F, C3I Advanced Development.										
(U)	This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602702F Command Control and Communications**	PROJECT NUMBER AND TITLE **4594 Information Technology**

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5581	Command and Control (C2) Technology	44.810	49.696	39.876	35.584	49.132	45.263	42.076	43.071	Continuing	TBD
	Quantity of RDT&E Articles	0	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 and control. 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 rapidly detect, classify, identify, and continuously track objects and events will improve the awareness and understanding and prediction of adversarial 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 2006	FY 2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Investigate and develop technologies for the rapid development and application of next generation knowledge bases for aerospace C2 systems.	6.816	7.730	6.499	5.501
(U)	In FY 2006: Demonstrated tools that will automate the intelligent extraction, correlation, and classification of link patterns for discovering relevant linkages between entities. Developed technologies for the rapid development and application of next generation knowledge bases for aerospace C2 systems. Initiated 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. Initiated 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 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	knowledge bases for automated intelligent extraction, correlation, and classification of link patterns for discovering relevant linkages between entities.				
(U)	In FY 2008: Continue to develop 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. Continue to 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. Develop a prototype that will have the capability, given commander's policies and Rules of Engagement, to apply context-aware access control to rapidly detect significant events and initiate reprioritization as required using operational databases and an available information management infrastructure. Initiate development of automated capture and self-organization of knowledge in globally distributed respositories.				
(U)	In FY 2009: Continue to develop 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. Continue to 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. Continue development of automated capture and self-organization of knowledge in globally distributed respositories.				
(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.	12.293	13.622	10.241	9.320
(U)	In FY 2006: Developed 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. Developed advanced interactive displays suitable for deployment in harsh environments with C2 applications and command centers. Developed advanced techniques and AOC-based applications for information visualization for use in conjunction with multiple, heterogeneous data sets. Developed technologies to improve the fidelity, accuracy, and interconnection of computer-based wargames used to prepare contingency plans and response strategies. Initiated development of technologies for a holistic tool set that commanders can use to probe, study, analyze, visualize, reason, and predict activities in the				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

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.

(U) In FY 2008: Complete the development of 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 and around the battlespace. Develop an advanced mission planning process that will provide a self-healing, secure, rule-based automatic scheduling process that resembles an auction style planning capability. Initiate development of capabilities to be more agile within a net centric enabled environment. Develop timely option generation selection and coordination capabilities that account for uncertainty and missing and erroneous information, and supports intuitive decision making process between man and machine collaborating on complex, dynamic problems exploiting the respective strengths of machines (process lots of data) and human (analytical reasoning). Develop dynamic workflow and workload management capabilities to manage the command and control constellation of resources.

(U) In FY 2009: 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,

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	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. Continue development of capabilities to be more agile within a net centric enabled environment. Continue the development of timely option generation selection and coordination capabilities that account for uncertainty and missing and erroneous information, and supports intuitive decision making process between man and machine collaborating on complex, dynamic problems exploiting the respective strengths of machines (process lots of data) and human (analytical reasoning). Continue the development of dynamic workflow and workload management capabilities to manage the command and control constellation of resources.				
(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.	6.446	9.349	7.758	6.361
(U)	In FY 2006: Completed investigation of technologies to dynamically filter and fuse information and produce customized coalition information products. Developed technology approaches to rapidly assimilate appropriate coalition partners into appropriate COI Infospheres. Extended 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. Investigated the ability to perform and enforce role-based access control to these COI Infospheres. Focused 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. Developed techniques and tools that will ensure availability, integrity, and survivability of information within a coalition net-centric environment. Initiated 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

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 fused events. Continue development of publish/subscribe technologies for application to a CBDN system for intelligent network management of user information.

(U) In FY 2008: 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. Continue to 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 fused events. Continue development of publish/subscribe/query technologies for application to a content-based delivery networking (CBDN) system for intelligent network management of user information. Initiate development of technologies to systematically integrate information sources across COI's.

(U) In FY 2009: Complete 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. Continue to 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. Continue to 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 fused events. Continue development of publish/subscribe/query technologies for application to a content-based delivery networking (CBDN) system for intelligent network management of user information. 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. Initiate techniques in characterization for an integration of pedigrees across organizational entities.

(U)

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602702F Command Control and Communications**	PROJECT NUMBER AND TITLE **5581 Command and Control (C2) Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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.	9.516	9.909	7.924	6.951
(U)	In FY 2006: Developed technologies to dynamically and rapidly assess the battlespace with a special emphasis on effects based assessment. Investigated application of decision support sciences to C2 activities within a Coalition AOC. Extended Course of Action analysis capability to allow collaboration between geographically remote locations. Developed intelligent information systems capable of supporting joint/coalition C2 for various missions. Developed and applied semantic ontology technologies for use in C2 applications, such as effects-based planning and dynamic tasking. Developed tools to increase situational awareness through intelligent information push and pull in dynamic environments. Investigated 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. Prototyped these techniques and demonstrated feasibility and usefulness. Explored 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 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)	In FY 2008: Continue to investigate application of decision support sciences and advanced				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

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 and understanding through intelligent information processing. Continue the application of system-of-systems and federation-of-systems engineering in the creation of joint C2 capabilities. Continue to explore the application of intelligent software agents as virtual battle staff members to enhance various C2 processes. Complete the development and demonstration of an effects-based dynamic tasking process enabled by dynamically accessible data and information services. Initiate development of capability for a full-spectrum analysis for effects attainment at all levels of a campaign, linking leading indicators to desired and undesirable effects. The capability will utilize causal reasoning, linking effects to actions to desired end-state, will develop non-deterministic, non-linear causal linkages, and will be capable of reasoning through uncertainty & ambiguity. Initiate research to achieve the ability to predict the current and future impact of an adversary cyber attack on Air Force (AF) information systems. Develop effects-based defense models to help predict the 1st and 2nd order impact of cyber attacks on an information system/mission. Develop Cyber defense containment scenarios that minimize current and future adversary impact to net-centric warfare (NCW) mission.

(U) In FY 2009: 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 and understanding through intelligent information processing. Continue the application of system-of-systems and federation-of-systems engineering in the creation of joint C2 capabilities. Continue to explore the application of intelligent software agents as virtual battle staff members to enhance various C2 processes. Continue research to achieve the ability to predict the current and future impact of an adversary cyber attack on AF information systems. Continue the development of effects-based defense models to help predict the 1st and 2nd order impact of cyber attacks on an information system/mission. Continue the development of Cyber defense containment scenarios that minimize current and future adversary impact to NCW mission. Continue the development of capability for a full-spectrum analysis for effects attainment at all levels of a campaign, linking leading indicators to desired and undesirable effects. The capability will utilize causal reasoning, linking effects to actions to desired end-state, will develop non-deterministic, non-linear causal linkages, and will be capable of reasoning through

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	uncertainty & ambiguity.				
(U)					
(U)	MAJOR THRUST: 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.	3.968	2.177	2.023	1.901
(U)	In FY 2006: Investigated and developed 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. Completed 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. Completed investigation of 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. Completed 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. Developed 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. Investigated automated methods of tailoring the user perspective of the COI Infosphere to reduce information overload and increase information awareness and utilization. Focused on automated composition of tailoring entities, and runtime environments. Investigated 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. Focused on representation of real-time performance guarantees and negotiation for various levels of service as would be required in tactical aircraft. Investigated and assessed the use of semantic markup and semantic web languages as part of the COI Infosphere. Initiated the investigation of technology and approaches to prioritizing information in a COI Infosphere so as to effectively utilize communication and computing resources. Develop technology and techniques to monitor, obtain feedback, and assert control over the COI Infosphere.				
(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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

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) In FY 2008: 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. Continue to investigate the security policy enforcement between COI Infospheres at various levels of security classification. 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. Initiate decentralization and fault tolerant information management services for the tactical environment. Initiate development of information transformation services and adaptive information management services that learn, self-configure, self-manage, and are self-healing. Initiate a study on collaboration services on demand that will exploit dynamic information services matching end user devices (laptops, cell phones, etc.) with appropriate information formats.

(U) In FY 2009: 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. Develop the security policy enforcement between COI Infospheres at various levels of security classification. Investigate methods and techniques for dynamically evolving the net-centric environment so as to avoid system crashes or latency by exploiting information technologies based on Quality of Service mechanism. Initiate integration of information services across operational boundaries and dissimilar infrastructure based systems. Continue development of information transformation services and adaptive information management

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602702F Command Control and Communications**	PROJECT NUMBER AND TITLE **5581 Command and Control (C2) Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	services that learn, self-configure, self-manage, and are self-healing. Continue study on collaboration services on demand that will exploit dynamic information services matching end user devices (laptops, cell phones, etc.) with appropriate information formats.				
(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. This effort includes Congressional Add funding of $3.8 million in FY 2006 and $1.0M in FY 2007.	5.771	6.909	5.431	5.550
(U)	In FY 2006: Developed 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. Developed distributed collaborative environment technology for operations other then war and similar applications. Conducted Congressionally-directed efforts for an Advanced Collaborative Platform for Netcentric Command and Control, and for Decision Support Tools. Conducted Congressionally-directed efforts for an Advanced Collaborative Platform for Net-Centric Command and Control (C2), 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, including data exchange protocols, access privileges and data access. 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. Conduct Congressionally directed effort for Advanced Collaborative Platform for Net-Centric Command and Control (C2).				
(U)	In FY 2008: 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. Continue to 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. Initiate a study on collaboration services on demand that will exploit dynamic information services matching end user devices (laptops, cell phones, etc.) with appropriate information formats. Support context aware collaborative user interfaces and semantic interoperability.				
(U)	In FY 2009: Continue development of advanced information technologies for collaborative				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	decision-making and knowledge management in support of capability-based planning and next generation planning, execution, and assessment environments. Continue to 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. Continue study on collaboration services on demand that will exploit dynamic information services matching end user devices (laptops, cell phones, etc.) with appropriate information formats. Support context aware collaborative user interfaces and semantic interoperability				
(U)					
(U)					
(U)					
(U)					
(U)					
(U)					
(U)	Total Cost	44.810	49.696	39.876	35.584

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
66SP Space Optical Network Tech	0.000	16.130	17.217	11.095	9.987	10.243	10.005	10.193	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop and assess optical network technologies for application in the space environment.	0.000	1.534	1.520	3.030
(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) In FY 2008: Complete demonstration of 16 x 16 optical data router and optical backbone interface chips for integration with on board Integrated Core Processor. Initiate design and development of 40 channel multi-wavelength optical network for on-board air and space applications				
(U) In FY 2009: Continue development of 40 channel multi wavelength optical network for on-board air and space applications				
(U)				
(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop and assess existing and emerging Optical CDMA and WDM modulation schemes and protocols for use in space-based optical networks. NOTE: This thrust contains $1.1M in Congressional add funding in FY2007.	0.000	4.110	3.574	1.833

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602702F Command Control and Communications**	PROJECT NUMBER AND TITLE **66SP Space Optical Network Tech**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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. Develop and demonstrate a compact, highly integrated optical interconnect for space based optical networking through research placing greater emphasis on wavelength division multiplexing (WDM) rather than spatial parallelism. Conduct Congressionally directed effort for Massively Parallel Optical Interconnects.				
(U)	In FY 2008: Continue design and development of optical burst switching and optical label switching protocols for applicability to air and space-based optical networks. Complete flight demonstration of industry standard single mode optical communications bus interface chip for airborne platforms				
(U)	In FY 2009: Initiate flight demonstration of multi gigabit multi wavelength optical communications bus interface chip for space and air platforms.				
(U)					
(U)	MAJOR THRUST/CONGRESSIONAL ADD: 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. NOTE: This thrust contains $1.6M in Congressional add funding.	0.000	8.294	12.123	6.232
(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. Develop and demonstrate a tunable chirp managed, directly modulated laser transmitter for extremely high data rates in free space optical communications. Conduct Congressionally directed effort for Digital Free-Space Optical Laser Transmitter Modems.				
(U)	In FY 2008: Complete the characterization of the combiner RF/laser communications brassboard. Design and develop higher throughput RF waveform data link technology for operation under adverse weather conditions. Conduct flight demonstration of combined RF/laser communications brassboard in cooperation with the demonstration of advanced airborne sensor technologies.				
(U)	In FY 2009: Complete the development and start the characterization of higher throughput RF				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602702F Command Control and Communications**	PROJECT NUMBER AND TITLE **66SP Space Optical Network Tech**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	waveform data link technology for operation under adverse weather conditions. Initiate the design of an integrated RF/laser communications airborne qualifiable brassboard.				
(U)	CONGRESSIONAL ADD: Space Qualified Common Data Link	0.000	2.192	0.000	0.000
(U)	In FY2006: Not Applicable				
(U)	In FY2007: Develop space qualified Common Data Link hardware, and extend the performance of the hardware to insure the hardware will have an environmental robustness to operate in the space environment				
(U)	In FY2008: Not Applicable				
(U)	In FY2009: Not Applicable				
(U)					
(U)	Total Cost	0.000	16.130	17.217	11.095

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0603789F, C3I Advanced Development.										
(U)	This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
02 Applied Research

PE NUMBER AND TITLE
0602805F Dual Use Science & Technology

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	0.962	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
4770	Dual Use Science and Technology (S&T)	0.962	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2006, this PE was 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. 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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	0.986	0.000		
(U)	Current PBR/President's Budget	0.962	0.000		
(U)	Total Adjustments	-0.024			
(U)	Congressional Program Reductions				
	Congressional Rescissions				
	Congressional Increases				
	Reprogrammings				
	SBIR/STTR Transfer	-0.024			

(U) Significant Program Changes:

In FY 2006, this PE was cancelled as a result of higher Air Force priorities.

C. Performance Metrics

(U) Under Development

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
02 Applied Research	**0602805F Dual Use Science & Technology**	**4770 Dual Use Science and Technology (S&T)**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4770	Dual Use Science and Technology (S&T)	0.962	0.000	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	0		

Note: In FY 2006, this PE was 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. 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.

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	CONGRESSIONAL ADD: Project HMA	0.962	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Project HMA.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable				
(U)	In FY 2009: Not Applicable				
(U)	Total Cost	0.962	0.000	0.000	0.000

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 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.
(U) PE 0603216F, Aerospace Propulsion and Power Technology.
(U) PE 0603231F, Crew Systems and Personnel Protection Technology.
(U) PE 0603270F, Electronic

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

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.
This program has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2007

BUDGET ACTIVITY
02 Applied Research

PE NUMBER AND TITLE
0602890F High Energy Laser Research

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	50.271	52.136	50.303	51.159	58.588	58.572	55.985	57.008	Continuing	TBD
5096	High Energy Laser Research	50.271	52.136	50.303	51.159	58.588	58.572	55.985	57.008	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 (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. 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 little or 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 2007, Congress added $2.2 million for Air Laser Technology Development. 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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	46.669	50.166	50.737	55.026
(U)	Current PBR/President's Budget	50.271	52.136	50.303	51.159
(U)	Total Adjustments	3.602			
(U)	Congressional Program Reductions		-0.032		
	Congressional Rescissions	-0.002	-0.198		
	Congressional Increases		3.200		
	Reprogrammings	4.824	-1.000		
	SBIR/STTR Transfer	-1.220			

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics
Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5096 High Energy Laser Research	50.271	52.136	50.303	51.159	58.588	58.572	55.985	57.008	Continuing	TBD
Quantity of RDT&E Articles	0	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 (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. 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 little or 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 2007, Congress added $2.2 million for Air Laser Technology Development. 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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Advance solid-state laser development, to include advanced technology demonstrations up to a Technology Readiness Level of 6.	10.910	10.524	10.271	9.424
(U) In FY 2006: Awarded contracts for phase III of the Joint High Power Solid State Laser (JHPSSL) project, to demonstrate 100 kilowatt laser devices. Conducted necessary studies to understand and improve field ability of solid state lasers.				
(U) In FY 2007: Participate in the 100 kilowatt JHPSSL demonstration. Analyze successful pieces from applied research projects (e. g. long-life diode laser drivers, thin-disc amplifiers, and fiber laser amplifiers) for future advanced demonstration of solid state laser systems.				
(U) In FY 2008: Continue to participate in the 100 kilowatt JHPSSL project. Provide for independent government-sponsored measurements of the 100 kilowatt laser(s). Initiate a joint high-power beam director development effort, suitable for mating with the JHPSSL phase III laser device.				
(U) In FY 2009: The 100 kilowatt laboratory demonstration will occur during this period. Continue with the joint high-power beam director development effort, suitable for mating with the JHPSSL phase III laser device.				
(U)				
(U) MAJOR THRUST: Mature technologies that will provide system level performance commensurate with fieldable solid-state laser devices	8.720	7.733	8.232	8.686

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2006: Conducted research to enable power scaling with reduced optical distortion, improved efficiency, and improved mass/weight characteristics. Developed scaleable architectures for beam combining. Examined architecture improvements, such as elimination of free-space optics in fiber systems. Conducted an industry proposal call for FY 2006; awarded eight contracts.				
(U)	in FY 2007: Develop technology that will lead to improved laser gain material and single mode fiber suitable for beam combination. Improve the efficiency and reliability of diode pump sources. Conduct Service and Agency proposal call for FY 2007.				
(U)	In FY 2008: Develop technology that will lead to improved fieldability, serviceability, and ruggedness. Develop power scaling architectures with good beam quality and suitable mass and weight. Conduct an industry proposal call for FY 2008.				
(U)	In FY 2009: Develop technology that will lead to improved fieldability, serviceability, and ruggedness. Develop power scaling architectures with good beam quality and suitable mass and weight. Conduct Service and Agency proposal call for FY 2009.				
(U)					
(U)	MAJOR THRUST: Investigate new technologies that have revolutionary potential for HEL applications.	2.199	2.189	2.411	2.529
(U)	In FY 2006: Explored novel laser technologies to have increase efficiency and decrease mass/volume. Integrated short-pulse laser technology into this initiative. Conducted an industry proposal call for FY 2006, awarded three contracts.				
(U)	In FY 2007: Explore novel laser technologies to increase efficiency and decrease mass/volume. Integrate short-pulse laser technology into this initiative. Conduct a Service and Agency proposal call for FY 2007.				
(U)	In FY 2008: Explore novel laser technologies to increase efficiency and decrease mass/volume. Conduct a Service and Agency proposal call for FY 2008.				
(U)	In FY 2009: Explore novel laser technologies to increase efficiency and decrease mass/volume. Conduct a Service and Agency proposal call for FY 2009.				
(U)					
(U)	MAJOR THRUST: Explore free electron lasers (FEL) that have potential in future HEL weapons. Conduct system level technology development and trade studies to facilitate scaling FELs to weapons-class power levels and shipboard integration.	9.330	9.463	10.028	10.153
(U)	In FY 2006: Conducted research in power scaling for a 100 kilowatt class FEL. Designed				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	high-average-current photocathode and injector capability, suitable beam-breakup thresholds, and power scaling capability of the optical resonator. Continued component testing with the 10 kilowatt laboratory device to define a development path for scaling to a 100 kilowatts. Conducted an industry proposal call for FY 2006, awarded seven contracts.				
(U)	In FY 2007: Demonstrate high average current photocathode and injector capability, suitable beam-breakup thresholds, and power scaling of the optical resonator. Complete the 10 kilowatt laboratory demonstration. Conduct a Service and Agency proposal call for FY 2007.				
(U)	In FY 2008: Continue to investigate the development path for scaling to a 100 kilowatt lab demonstration. Conduct an industry proposal call for FY 2008				
(U)	In FY 2009: Continue to investigate the development path for scaling to a 100 kilowatt lab demonstration. Conduct a Service and Agency proposal call for FY 2009.				
(U)					
(U)	MAJOR THRUST: Conduct technology experiments to select promising chemical generator and chemical regeneration technologies that can be scaled for weapons application.	5.420	7.303	5.690	6.057
(U)	In FY 2006: Developed and demonstrated closed-cycle chemical laser, focused on chemical oxygen iodine (COIL) devices. Explored novel concepts on electric-gas phase laser generation. Conducted an industry proposal for FY 2006, awarded five contracts.				
(U)	In FY 2007: Demonstrate closed-cycle COIL devices. Demonstrate electric-oxygen pumping schemes to minimize the chemistry. Develop electric-gas phase laser generation technologies. Fund Air Laser Project to produce oxygen deltlets through electric pumping. Conduct a Service and Agency proposal call for FY 2007.				
(U)	In FY 2008: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct an industry proposal call for FY 2008.				
(U)	In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a Service and Agency proposal call for FY 2009.				
(U)					
(U)	MAJOR THRUST: Develop technology to support high performance beam control systems and integrated demonstrations.	8.560	8.918	9.615	10.234
(U)	In FY 2006: Explored advanced component and control techniques for difficult environments, such as high speed flight, high turbulence, and extended ranges. Advanced high performance beam control techniques, to include conformal and tiled apertures, and fiber-based technologies. Continued the study				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	of atmospheric limitations at low altitude, such as turbulence, thermal blooming, and platform disturbances. Conducted an industry proposal for FY 2006, awarded eight contracts.				
(U)	In FY 2007: Develop beam control technologies, such as all-fiber systems with conformal apertures and active controls for boundary layer mitigation. Complete atmospheric compensation technologies. Conduct a Service and Agency proposal call for FY 2007.				
(U)	In FY 2008: Develop/provide beam control technology options for laser weapon use on multiple platforms (aircraft, ground vehicles and shipboard systems). Conduct an industry proposal call for FY 2008.				
(U)	In FY 2009: Develop/provide beam control technology options for laser weapon use on multiple platforms (aircraft, ground vehicles and shipboard systems). Conduct a Service and Agency proposal call for FY 2009.				
(U)					
(U)	MAJOR THRUST: Develop a lethality database, and integrate into a systems-level architecture plan.	3.500	3.814	4.056	4.076
(U)	In FY 2006: Developed a predictive, physics-based methodology for prediction of target lethality based on an understanding of the mechanism of laser/target material interaction. Developed databases that will be accepted by the HEL community, and integrated in validated models for laser systems designers.				
(U)	In FY 2007: Catalog existing lethality databases for common use. Develop an architecture plan to consolidate and compare historical data. Initiate laser systems inputs for the Joint Munitions Effect Manual.				
(U)	In FY 2008: In close coordination with existing HEL models, integrate lethality data into campaign-level HEL system models. Develop laser systems inputs for the Joint Munitions Effect Manual.				
(U)	In FY 2009: In close coordination with existing HEL models, integrate lethality data into campaign-level HEL system models. Develop laser systems inputs for the Joint Munitions Effect Manual.				
(U)					
(U)	CONGRESSIONAL ADD: High Power Fiber Laser Program.	1.152	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for the High Power Fiber Laser Program.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602890F High Energy Laser Research**	PROJECT NUMBER AND TITLE **5096 High Energy Laser Research**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)					
(U)	CONGRESSIONAL ADD: Oxygen Laser Optical Source.	0.480	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for the Oxygen Laser Optical Source.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Air Laser Technology Development.	0.000	2.192	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort in Air Laser technology Development.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	50.271	52.136	50.303	51.159

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	PE 0602500F, Multi-Disciplinary Space Technology.										
(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										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

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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Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2007

BUDGET ACTIVITY: **03 Advanced Technology Development (ATD)**

PE NUMBER AND TITLE: **0603112F Advanced Materials for Weapon Systems**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	65.193	82.290	39.730	39.324	48.652	46.771	47.742	48.924	Continuing	TBD
2100	Laser Hardened Materials	26.653	35.689	25.610	26.409	34.036	32.012	32.676	33.485	Continuing	TBD
3153	Non-Destructive Inspection Development	13.287	15.885	3.772	3.875	4.389	4.449	4.542	4.653	Continuing	TBD
3946	Materials Transition	19.163	14.755	3.742	3.791	4.276	4.265	4.354	4.461	Continuing	TBD
4918	Deployed Air Base Demonstrations	6.090	10.864	2.216	2.274	2.581	2.625	2.679	2.746	Continuing	TBD
77SP	Advanced Space Materials	0.000	5.097	4.390	2.975	3.370	3.420	3.491	3.579	Continuing	TBD

Note: In FY 2007, Project 77SP, Advanced Space Materials, efforts transfer 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 2007 Congressionally-directed Advanced Inspection Techniques and Analysis Methods for Multi-layer Structures and Widespread Fatigue Damage in Aging Military Aircraft in the amount of $1.1 million are in the process of being moved to PE 0603112F, Advanced Materials for Weapon Systems, from PE 0702207F, Depot Maintenance, 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 2007, Congress added $1.2 million for Large Panel Sapphire Producibility, $2.3 million for Metals Affordability Initiative, $1.6 million for Encapsulated Ballistic Protection System, $1.0 million for Combined Agent Fire Fighting System, $1.0 million for Continuous Integrated Vehicle Health Monitoring System, $2.0 million for Aging Aircraft Fleet Support - National Institute for Aviation Research, $1.0 million for Low Observable Multi-Purpose Inspection Tool, $1.0 million for Coated Field Repair, $1.0 million for Optical Filters for Hardened Night Vision Goggles, $1.3 million for Blast-Resistant Barriers and Structural Design for Homeland Defense, $1.8 million for Advanced Power Technology: Silicon-Carbide Power, Bipolar Junction Transistors, $2.0 million for Assessing Aging of Military Aircraft, $3.3 million for Hydrothermal Oxidation (HTO) for Alaska, $2.0 million for Improved Stealth Aircraft Availability/Functionality, $2.0 million for Inspection and Analysis Methods for Aging Military Aircraft, $1.0 million for Materials Integrity Management Research for AF Systems, $5.8 million for Silicon Carbide Electronics Material Producibility Initiative, $1.0 million for Quantitative Inspection Techniques for Assessing Aging Military Aircraft, and $1.4 million for Body Armor Underarm and Side Protection with Smart Materials. 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 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	70.100	48.901	43.519	45.465
(U)	Current PBR/President's Budget	65.193	82.290	39.730	39.324
(U)	Total Adjustments	-4.907			
(U)	Congressional Program Reductions				
	Congressional Rescissions	0.023	-0.311		
	Congressional Increases		33.000		
	Reprogrammings	-3.429	0.700		
	SBIR/STTR Transfer	-1.501			

(U) Significant Program Changes:

In FY 2007, Project 77SP, Advanced Space Materials, efforts transfer 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 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603112F Advanced Materials for Weapon Systems**	**2100 Laser Hardened Materials**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2100 Laser Hardened Materials	26.653	35.689	25.610	26.409	34.036	32.012	32.676	33.485	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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: This effort includes Congressional Add funding of $2.6 million in FY 2006 for Large Panel Sapphire Producibility and $1.2 million in FY 2007 for Large Panel Sapphire Producibility.	20.001	27.556	19.812	20.020
(U) In FY 2006: Developed a mid-wavelength infrared testbed based on a candidate optical system. Evaluated solid state limiter materials having potential for dual band operation. Evaluated 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) In FY 2008: Demonstrate mature hardening materials technology for an Air Force tactical system. Characterize and incorporate candidate dual band limiter materials for tactical systems. Demonstrate protection strategies for large format CCDs.				
(U) In FY 2009: Transition mature hardening materials technology for an Air Force tactical system. Demonstrate performance of dual band limiter materials in tactical systems.				
(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 $1.0 million in FY 2007 for Optical Filters for Hardened Night Vision Goggles (NVGs).	6.652	8.133	5.798	6.389
(U) In FY 2006: Developed and characterized an NVG brassboard system using state-of-the-art agile filters and optical power limiters. Developed agile filter and optical limiter technologies.				
(U) In FY 2007: Demonstrate brassboard performance using state-of-the-art agile filters and optical power				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	limiters. Characterize and incorporate agile filter and optical limiter technologies into devices for Air Force applications.				
(U)	In FY 2008: Validate performance of state-of-the-art agile filters and optical power limiters in a system configuration. Optimize agile filter and optical limiter devices for Air Force applications.				
(U)	In FY 2009: Transition advanced agile filters and optical power limiters technologies in a system configuration. Demonstrate agile filter and optical limiter devices for Air Force applications.				
(U)	Total Cost	26.653	35.689	25.610	26.409

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) C. Other Program Funding Summary ($ in Millions)

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603112F Advanced Materials for Weapon Systems**	**3153 Non-Destructive Inspection Development**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3153	Non-Destructive Inspection Development	13.287	15.885	3.772	3.875	4.389	4.449	4.542	4.653	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: Funds for the FY 2007 Congressionally-directed Advanced Inspection Techniques and Analysis Methods for Multi-layer Structures and Widespread Fatigue Damage in Aging Military Aircraft in the amount of $1.1 million are in the process of being moved to PE 0603112F, Advanced Materials for Weapon Systems, from PE 0702207F, Depot Maintenance, 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 2006	FY 2007	FY 2008	FY 2009
(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.	1.042	0.891	0.486	0.533
(U) In FY 2006: Demonstrated methods to detect and characterize damage in repaired (linear friction welded) turbine engine components. Validated 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 superalloy engine components.				
(U) In FY 2008: Develop NDI/E approaches to extend the life of fracture-critical gas turbine engine components.				
(U) In FY 2009: Validate 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.	0.624	0.315	0.266	0.292
(U) In FY 2006: Developed and demonstrated a portable, multifunctional, multiplatform diagnostics tool for use in battle damage assessment and repair of LO materials and structures.				
(U) In FY 2007: Transition a portable, multifunctional, multiplatform diagnostics tool for use in battle				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	damage assessment and repair of LO materials and structures.				
(U)	In FY 2008: Develop and demonstrate multiuse, multiplatform LO NDI/E hand tool that meets user requirements.				
(U)	In FY 2009: Transition multiuse, multiplatform LO NDI/E hand tool that meets user requirements.				
(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 $7.9 million in FY 2006 ($2.1 million for Assessing Aging Military Aircraft, $4.8 million for Aging Military A/C Fleet Support at National Institute for Aviation Research, and $1.0 million for Non-Destructive Testing (NDI) Corrosion Detection) and $7.0 million in FY 2007 ($2.0 million for Aging Aircraft Fleet Support - National Institute for Aviation Research, $2.0 million for Assessing Aging of Military Aircraft, $2.0 million for Inspection and Analysis Methods for Aging Military Aircraft, and $1.0 million for Quantitative Inspection Techniques for Assessing Aging Military Aircraft).	8.835	8.310	1.631	1.639
(U)	In FY 2006: Transitioned advanced electromagnetic techniques to detect cracks in multiple layers to meet aging aircraft life extension requirements. Identified and developed 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)	In FY 2008: Validate NDI/E technologies to meet emerging inspection requirements for aging aircraft and develop processes.				
(U)	In FY 2009: Transition 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 $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) and $2.0 million in FY 2007 ($1.0 million for Materials Integrity Management Research for AF Systems and $1.0 million for Continuous Integrated	2.786	3.381	1.389	1.411

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	Vehicle Health Monitoring System).				
(U)	In FY 2006: Developed sensors to monitor real-time health of high-temperature protection systems. Developed smart sensor technologies for wiring health analysis. Developed 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 wiring health analysis. Validate field-level inspection tools for assessing the structural health of airframes.				
(U)	In FY 2008: Develop optimal sensing approaches for real-time health monitoring of high-temperature protection systems and characterize power scavenging and signal transmission issues. Develop improved, smaller smart sensor technologies for wiring health analysis. Develop data fusion to be used with field-level inspection tools for assessing the structural health of airframes.				
(U)	In FY 2009: Develop optimal sensing approaches for real-time health monitoring of high-temperature protection systems and characterize power scavenging and signal transmission issues. Transition smart sensor technologies for wiring health analysis. Transition total field-level inspection tool for assessing the structural health of airframes.				
(U)					
(U)	CONGRESSIONAL ADD: Low Observable Multi-Purpose Inspection Tool.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Low Observable Multi-Purpose Inspection Tool.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Improved Stealth Aircraft Availability/Functionality.	0.000	1.992	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Improved Stealth Aircraft Availability/Functionality.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	13.287	15.885	3.772	3.875

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) C. Other Program Funding Summary ($ in Millions)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602102F, Materials.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603112F Advanced Materials for Weapon Systems**	**3946 Materials Transition**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3946 Materials Transition	19.163	14.755	3.742	3.791	4.276	4.265	4.354	4.461	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(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 2006	FY 2007	FY 2008	FY 2009
(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 $13.9 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, $2.5 million for Stealth RAM Coatings, and $1.7 million for Body Armor and Fragmentation Protection) and $2.3 million in FY 2007 for Metals Affordability Initiative.	16.994	5.665	3.523	2.666

(U) In FY 2006: Developed materials-damage predictive approaches for engine health determination and life extension capability. Transitioned reliable life extension capability for turbine engine rotors. Developed and demonstrated high temperature composites for turbine engine applications and initiate transition of these materials to relevant platforms. Scaled-up advanced materials and initiated scale-up of fabrication processes to increase the capabilities of coated conductors for ultra-lightweight, ultra-high power generation for airborne directed energy weapons. Evaluated materials properties for a mid-infrared laser source enabling aircraft countermeasures and integrated best material improvement methods. Investigated primer/sealer material for improved durability of LO materials in fluid contaminated areas on emerging fighter aircraft. Developed flexible/lightweight conductive gap filler for LO aircraft. Developed processes for removal of radar absorbing material on large aircraft areas. Developed hot-melt conductive fastener fill. Improved processing of room-temperature-storable radar absorbing structure repair materials. Developed non-destructive evaluation tool for limited access areas on aircraft.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603112F Advanced Materials for Weapon Systems**	PROJECT NUMBER AND TITLE **3946 Materials Transition**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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)	In FY 2008: Validate materials-damage predictive approaches for engine health determination and life extension capability. Transition advanced materials and materials process capabilities for component-level demonstrations of power generation materials for airborne directed energy weapons. Transition materials and processing concepts for component-level demonstrations of new material for enabling mid-IR laser output with energy sufficient for enabling new aircraft self-protection schemes. Transition flexible/lightweight conductive gap filler. Validate advanced materials and processing technologies for transition to fielded and planned Air Force weapon, airframe, and propulsion applications as well as support systems including Air Force Material Command (AFMC) center infrastructure.				
(U)	In FY 2009: Validate materials-damage predictive approaches for engine health determination and life extension capability. Transition advanced materials and processing technologies to fielded and planned Air Force weapon, airframe, and propulsion applications as well as support systems including AFMC center infrastructure.				
(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 $2.0 million in FY 2006 ($1.0 million for Coated Field Repair and $1.0 million for Room Temperature Nanocrystalline Diamond Coating for De-Icing) and $1.0 million in FY 2007 for Coated Field Repair.	2.169	1.519	0.219	1.125
(U)	In FY 2006: Developed test methodologies and evaluation techniques to facilitate transition of				

Exhibit R-2a, RDT&E Project Justification

DATE
February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603112F Advanced Materials for Weapon Systems**	**3946 Materials Transition**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	emerging materials and processes for sustainment of Air Force systems.				
(U)	In FY 2007: Develop test methodologies and evaluation techniques to facilitate transition of emerging materials and processes for sustainment of Air Force systems.				
(U)	In FY 2008: Identify and prioritize critical issues that are preventing transition of emerging materials and processes for sustainment of Air Force systems.				
(U)	In FY 2009: Develop test methodologies and evaluation techniques to facilitate transition of emerging materials and processes for sustainment of Air Force systems.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Power Technology: Silicon Carbide Power, Bipolar Junction Transistors.	0.000	1.793	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Advanced Power Technology: Silicon Carbide Power, Bipolar Junction Transistors.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Silicon Carbide Electronics Material Producibility Initiative.	0.000	5.778	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Silicon Carbide Electronics Material Producibility Initiative.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	19.163	14.755	3.742	3.791

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0602102F, Materials.										
(U)	PE 0603203F, Advanced Aerospace Sensors.										
(U)	PE 0603211F, Aerospace										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

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 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603112F Advanced Materials for Weapon Systems**	**4918 Deployed Air Base Demonstrations**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4918	Deployed Air Base Demonstrations	6.090	10.864	2.216	2.274	2.581	2.625	2.679	2.746	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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 $1.7 million in FY 2006 for Hydrothermal Oxidation and $3.3 million in FY 2007 for Hydrothermal Oxidation (HTO) for Alaska.	2.639	4.436	0.902	0.945

(U) In FY 2006: Demonstrated a 10 kW fuel cell power system that improves deployable power systems performance. Demonstrated packed bed fuel treatment technology to remove sulfur and integrate with both proton exchange membrane fuel cell and solid oxide fuel cell stacks. Developed 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. Developed 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. Develop continuous load deflection technology and improved crater/spall repair materials and methodologies for improved airfield assessment and rapid repair.

(U) In FY 2008: Develop transition plan and specifications for system development and demonstration. Characterize catalytic and surface chemistry technologies for application to bare base utilities. Develop and demonstrate continuous load deflection technologies and improved crater/spall repair.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Develop best methods for integration of advanced power generation and distribution. Characterize and ensure processes for innovative technologies. Begin development and demonstration of miniaturized airfield assessment technologies.				
(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.	3.451	1.148	1.314	1.329
(U)	In FY 2006: Demonstrated improved blast suppression technologies and fragmentation protection materials for new and existing structures. Initiated demonstration of explosive storage protective technologies. Demonstrated improved fire fighter safety technologies. Developed advanced air filtration technologies for expeditionary structures.				
(U)	In FY 2007: Demonstrate 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)	In FY 2008: Develop and analyze effectiveness of improved blast suppression technologies and fragmentation protection materials for new and existing structures. Demonstrate explosives detection technologies. Transition technical orders and construction standards supporting fire suppression technologies for fire fighter safety technologies. Evaluate ultrahigh pressure, standoff nozzles, and other innovative technologies with test bed vehicles. Develop air filtration and model/evaluate reactive filtration effectiveness for expeditionary structures.				
(U)	In FY 2009: Validate and fabricate improved blast suppression technologies and fragmentation protection materials for new and existing structures. Demonstrate and validate explosives detection technologies. Evaluate and characterize improved fire fighter safety technologies and transition technology to operational units. Characterize and analyze/evaluate ultrahigh pressure, standoff nozzles, and other innovative technologies with test bed vehicles. Characterize air filtration and model/evaluate reactive filtration effectiveness for expeditionary structures.				
(U)					
(U)	CONGRESSIONAL ADD: Blast Resistant Barriers and Structural Design for Homeland Defense.	0.000	1.295	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Blast Resistant Barriers and Structural Design for Homeland Defense.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Body Armor Underarm and Side Protection with Smart Materials.	0.000	1.395	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Body Armor Underarm and Side Protection with Smart Materials.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Combined Agent Fire Fighting System.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Combined Agent Fire Fighting System.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Encapsulated Ballistic Protection System.	0.000	1.594	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Encapsulated Ballistic Protection System.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	6.090	10.864	2.216	2.274

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602102F, Materials.										
(U) PE 0603287F, Physical										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) C. Other Program Funding Summary ($ in Millions)

Security Equipment.

(U) PE 0604617F, Agile Combat Support.

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE
February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603112F Advanced Materials for Weapon Systems**	**77SP Advanced Space Materials**

Cost ($ in Millions)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
77SP	Advanced Space Materials	0.000	5.097	4.390	2.975	3.370	3.420	3.491	3.579	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2007, Project 77SP, Advanced Space Materials, efforts transfer 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 2006	FY 2007	FY 2008	FY 2009
(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	5.097	2.029	1.439
(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) In FY 2008: Refine developed materials formulations and approaches for thermal protection systems and aeroshells that provide solutions for cost-effective scale-up, fabrication, and integration techniques. Validate performance of high temperature composites on integrated cryogenic tanks and hypersonic structures, demonstrating low cost component fabrication and scale-up of design and process methodologies.				
(U) In FY 2009: Utilizing newly developed materials approaches, fabricate thermal protection system				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	sub-components for high temperature testing. Develop a sub-component cryogenic tank article and conduct studies to demonstrate the integration of ceramic, metallic, and carbon-carbon thermal protection system components.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate advanced materials technologies that enhance hardening for space systems. Note: In FY 2005, efforts in this major thrust were delayed until FY 2008 due to higher Air Force priorities.	0.000	0.000	2.361	1.536
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Optimize and validate limiter and filter technology for protection against low and high power lasers. Analyze laser phenomenology for intrinsic hardening solutions to jamming and damage susceptibility in electro-optical sensors.				
(U)	In FY 2009: Fabricate and demonstrate limiter and filter technology for protection of space systems. Investigate impact of inserting state-of-the-art filters and optical power limiters into a realistic system configuration.				
(U)	Total Cost	0.000	5.097	4.390	2.975

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Not Applicable.										

(U) D. Acquisition Strategy

Not Applicable.

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Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE
0603203F Advanced Aerospace Sensors

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	38.471	58.228	55.549	52.840	60.141	56.918	54.172	55.294	Continuing	TBD
665A	Advanced Aerospace Sensors Technology	12.573	16.428	14.800	13.020	23.074	20.184	16.707	16.570	Continuing	TBD
69DF	Target Attack and Recognition Technology	25.898	29.659	28.435	29.462	29.002	28.546	29.110	30.187	Continuing	TBD
88SP	Advanced Space Sensors	0.000	12.141	12.314	10.358	8.065	8.188	8.355	8.537	Continuing	TBD

Note: In FY 2006, efforts in Project 5019 transferred to Project 665A within this PE. In FY 2007, Project 88SP, Advanced Space Sensors, efforts transferred 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 three 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 electro-optical (EO) sensors, radar sensors and electronic counter-countermeasures (ECCM), and components and algorithms. The second project develops and demonstrates radio frequency (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 third project develops and demonstrates space sensor technologies including RF sensors; intelligence, surveillance, and reconnaissance (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 2007, Congress added $1.3 million for National Operational Radar Signature Production and Research Capability (Combat Identification Signature Center); $1.0 million for TACNODES; and $1.0 million for Precision Image Tracking and Registration 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 electronic combat system developments that have military utility and address warfighter needs.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603203F Advanced Aerospace Sensors**

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

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	39.782	55.150	54.992	58.971
(U)	Current PBR/President's Budget	38.471	58.228	55.549	52.840
(U)	Total Adjustments	-1.311			
(U)	Congressional Program Reductions		-0.002		
	Congressional Rescissions	-0.001	-2.200		
	Congressional Increases		3.300		
	Reprogrammings	-0.416			
	SBIR/STTR Transfer	-0.894			

(U) Significant Program Changes:

In FY 2007, Project 88SP, Advanced Space Sensors, efforts transferred 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 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
665A	Advanced Aerospace Sensors Technology	12.573	16.428	14.800	13.020	23.074	20.184	16.707	16.570	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2006, efforts in Project 5019 within this PE transferred 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 2006	FY 2007	FY 2008	FY 2009
(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.	2.454	3.583	4.975	4.654

(U) In FY 2006: Completed multi-spectral passive cueing demonstration in an airborne environment. Developed 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. Analyzed advanced passive and multi-function active sensing methods to optimize detection and identification of difficult targets. Performed preliminary design for multi-mode unmanned aerial vehicle based sensor, including platform integration plans. Designed and fabricated optical components for long wave infrared spectral/polarimetric imager for high altitude sensor. Conducted in-house target and 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 sensor. Conduct flight test to demonstrate target detection capability. Finalize the design and initiate fabrication

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	of an engineering model for an improved 3D-laser radar (LADAR) system with improved range and resolution capability to support automated/assisted target recognition of obscured and urban targets.				
(U)	In FY 2008: Begin airborne experiments demonstrating multi-function active/passive EO/IR demonstration system to detect, locate, and identify difficult targets in both obscured and urban environments for ISR applications. Perform fabrication and testing of high-resolution, 3D-LADAR for high confidence target identification coupled with passive spectral imaging for low false alarm rate detection utilizing advanced change detection and spatial-spectral discrimination techniques. Perform concept demonstration of multispectral/polarimetric focal plane array device for enhanced low contrast target discrimination. Complete fabrication of improved 3D-LADAR system and conduct testing of the engineering model.				
(U)	In FY 2009: Complete airborne experiments demonstrating multi-function active/passive EO/IR demonstration system to detect, locate, and identify difficult targets in both obscured and urban environments for ISR applications. Characterize end-to-end performance of high-resolution, 3D-LADAR for high confidence target identification coupled with passive spectral imaging for low false alarm rate detection utilizing advanced change detection and spatial-spectral discrimination techniques. Complete development of multispectral/polarimetric focal plane array device for enhanced low contrast target discrimination, and design airborne sensor module for enhancement of multi-function demonstration system.				
(U)					
(U)	MAJOR THRUST: Develop EO sensor technologies to detect and locate camouflaged and concealed targets for aerospace ISR applications. Note: Efforts complete in FY 2007.	1.602	4.474	0.000	0.000
(U)	In FY 2006: Extended performance of a demonstration sensor for high altitude reconnaissance aircraft to incorporate an emissive spectral sensing capability. Fabricated, laboratory integrated, and tested 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop technologies to maximize positional accuracy, timing accuracy, and	1.740	2.080	2.092	1.988

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	exploitation techniques to improve offensive and defensive combat capabilities.				
(U)	In FY 2006: Developed critical experiments using virtual flight test simulation to characterize assured reference technologies for net centric warfare. Designed follow-on distributed position, navigation, and timing (PNT) advanced technology demonstration to optimize time-sensitive targeting, battlespace awareness, and persistent ISR capabilities. Improved report, track, and image georegistration technologies for multi-intelligence sensor data.				
(U)	In FY 2007: Demonstrate critical experiments to characterize assured reference technologies for net centric warfare. Develop sensor phenomenology-based georegistration for imagery and perform lab tests of multi-intelligence georegistration.				
(U)	In FY 2008: Develop worldwide ultra-accurate positioning system technologies to optimize time sensitive targeting, battlespace awareness, and persistent ISR capabilities. Continue to develop multi-sensor phenomenology-based georegistration for imagery and perform lab tests of multi-intelligence georegistration.				
(U)	In FY 2009: Demonstrate worldwide ultra-accurate positioning system technologies to optimize time sensitive targeting, battlespace awareness, and persistent ISR capabilities. Continue to develop multi-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 counter-countermeasures. Note: The growing emphasis in this thrust in FY 2008 and FY 2009 is due to the increased focus on high resolution radar (HRR).	6.278	3.528	6.467	5.398
(U)	In FY 2006: Flight tested a lightweight, low profile multi-function active electronically scanned array on an airborne test bed to demonstrate integrated radar technology capability. Analyzed data from flight test and predicted system performance on target platforms using advanced computational techniques. Demonstrated accurate, real-time detection and location with enhanced millimeter wave sensor. Demonstrated RF sensors for an integrated EO/RF sensor suite for UAVs with severe size, weight, and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

power constraints, to enable single platform persistent ISR capability compatible with a system of systems architecture. Constructed a multi-intelligence sensor suite ground test bed to emulate an airborne moving platform. Performed risk reduction efforts for airborne implementations. Conducted radar systems engineering support fostering the transition of developed enabling technologies and concepts to weapon systems and ISR assets. Developed integrated electronic support measures (ESM)/passive radar concept for enhanced target detection and tracking. Developed 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. Develop program for threat analysis/mitigation of passive multistatic, multi-intelligence sensing.

(U) In FY 2008: 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. Continue experiments with the ground test bed providing input into the required operation and controls 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. Initiate a radar system analysis for improved ground moving target detection using HRR advanced transmit waveform and mode techniques.

(U) In FY 2009: Complete 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. Enhance the ground test bed with the inclusion of EO sensing modes, and provide input into the required design for an integrated EO/RF sensor suite, including required data processing and exploitation. Continue sensor systems engineering support fostering the transition of developed enabling technologies and concepts to weapon systems and ISR assets. Continue experiments with the ground test bed providing input into a design for an airborne multi-intelligence experiment. Continue radar system analysis for improved ground moving target detection using HRR advanced transmit waveform and mode techniques.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(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.	0.499	0.771	1.266	0.980
(U)	In FY 2006: Demonstrated and evaluated adaptive processing techniques for multi-mission conformal arrays and wideband and polarization adaptive processing techniques for multi-function radar. Implemented novel space-time adaptive processing techniques that are robust to heterogeneous data. Developed 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)	In FY 2008: Demonstrate and evaluate multi-sensor waveform transmission and signal processing techniques on selected advanced computing architectures. Implement novel space-time adaptive processing techniques that are robust to heterogeneous data. Implement tactical sensor network operations on the developed advanced computer architectures used for algorithm/waveform analysis.				
(U)	In FY 2009: Demonstrate the surveillance performance of homogeneous sensor networks and newly developed adaptive processing algorithms and waveforms in heterogeneous conditions, including clutter and jamming interference.				
(U)					
(U)	CONGRESSIONAL ADD: Tactical Air Communication Nodes (TACNODES).	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for TACNODES.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Precision Image Tracking and Registration Program.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for the Precision Image and Tracking Registration Program.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603203F Advanced Aerospace Sensors**	PROJECT NUMBER AND TITLE **665A Advanced Aerospace Sensors Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	12.573	16.428	14.800	13.020

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0602204F, Aerospace Sensors.										
(U)	PE 0603205F, Flight Vehicle 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										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

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 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
69DF	Target Attack and Recognition Technology	25.898	29.659	28.435	29.462	29.002	28.546	29.110	30.187	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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.	4.906	5.025	5.666	0.267
(U) In FY 2006: Developed radar-based air-to-ground moving target algorithm for tactical and reconnaissance platforms. Analyzed and identified legacy system hardware/software upgrades required for algorithm transition to strike and reconnaissance platforms.				
(U) In FY 2007: Continue multi-spiral development 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) In FY 2008: Perform a real-time laboratory demonstration of a radar based air-to-ground moving target algorithm for tactical and reconnaissance platforms. Assess performance against scenarios of interest to the warfighter as would be integrated into candidate radar systems. Provide support to the transition of				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	the moving target algorithm technology to operational strike and reconnaissance platforms.				
(U)	In FY 2009: Continue providing support to the transition 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.	5.412	5.329	4.229	1.719
(U)	In FY 2006: 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. Completed the automation of data collection planning for transition of algorithms. Completed the initial ATR research and development (R&D) computer and networking infrastructure via software, hardware, and network integration enhancements. Completed the initial processing capabilities and the on-line Department of Defense (DoD)-wide repository for R&D sensor data. Completed the on-line 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. Assessed 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. Modeled platform and sensor systems in simulated operational environments. Assessed moving target tracking and identification approaches for multiple sensor types. Evaluated 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 automatic target recognition fusion algorithms using the Air Force ATR evaluation test facility for application to Air Force intelligence, surveillance, reconnaissance, 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 DoD-wide repository of R&D sensor data with multi-sensor imagery and tracking				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	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 Operations Centers. Initiate modeling of existing and emergent sensor systems for assessing automated exploitation technologies in simulated operational environments. Initiate assessment of moving target tracking and ID approaches for multiple sensor types. Initiate evaluation of technology enhancements for post-conflict force protection, stability, and security operations.				
(U)	In FY 2008: Begin spiral development and assessment of multi-sensor ATR fusion algorithms. Assessment of technology supporting Air Force intelligence, surveillance, reconnaissance, strike, and weapon systems will occur in the Air Force ATR evaluation test facility. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected R&D and operational data sets. Examine target, scene and scenario data to determine independence and interdependence of features to support development of an optimum data fusion exploitation capability. Enhance ATR evaluation test facility and data sets as required to support enhanced ATR fusion capabilities.				
(U)	In FY 2009: Continue spiral development and assessment of multi-sensor ATR fusion algorithms. Continue assessment of technology supporting Air Force intelligence, surveillance, reconnaissance, strike, and weapon systems using the Air Force ATR evaluation test facility. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected R&D and operational data sets. Develop ATR fusion sensor data exploitation capability utilizing analysis and experimentation of data independence and interdependence of features to support development of an optimum data fusion exploitation capability. Enhance ATR evaluation test facility and data sets as required to support enhanced ATR fusion capabilities. Determine technology shortfalls and develop ATR fusion technologies to overcome these shortfalls.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate a moderate confidence ATR and advanced cueing capability for stationary and moving targets. Note: Reduced emphasis on this effort in FY 2008 due to higher Air Force priorities.	3.389	9.267	7.816	10.620
(U)	In FY 2006: Developed 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. Conducted preliminary critical				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

experiments to refine high-level, near-term fusion processes. Conducted characterization studies of advanced stationary and moving target radar data to determine utility for automatic target recognition and advanced cueing (ATR/C) and combat identification. Conducted technology demonstration effort of promising near-term, multi-sensor technologies and fusion processing techniques. Analyzed characterization studies for advanced, multi-sensor, multi-platform fusion processing techniques. 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 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. Continue advanced multi-sensor data collections on stationary and moving targets.

(U) In FY 2008: Develop and evaluate an initial design of multi-sensor fusion algorithms that use change detection techniques to improve target detection and reduce false alarms for higher clutter areas. Develop and evaluate an initial design of a 3D-LADAR ATR algorithm designed to achieve high confidence identification against targets in various degrees of clutter. Develop and evaluate an initial design of a laser vibrometry algorithm that provides the ability to determine target state (engine on/off) and provides counter denial and deception capability. Develop and evaluate an initial design of a sensor management suite that provides target cue prioritizations and look geometry optimization for 3D-LADAR sensors. Develop and evaluate an initial set of exploitation tools that are optimized for use with 3D-LADAR and laser vibrometry sensors. Enhance ATR evaluation test facility and data sets as necessary to support program requirements.

(U) In FY 2009: Incorporate improvements in the initial design of the multi-sensor fusion algorithms for improved detection that were previously evaluated. Incorporate improvements in the initial design of the 3D-LADAR ATR algorithms that were previously evaluated. Incorporate improvements in the initial design of the laser vibrometry algorithms that were previously evaluated. Incorporate improvements in the initial design of the sensor management suite that were previously evaluated.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	Incorporate improvements in the initial set of laser sensor exploitation tools that were previously evaluated. Enhance ATR evaluation test facility and data sets to support program requirements.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate an ATR capability integrated with advanced georegistration techniques and innovative change detection algorithms.	5.291	5.853	2.846	1.112
(U)	In FY 2006: Completed integration and field test of ATR/C, georegistration, and change detection techniques. Utilized the advanced recognition capability test bed to integrate and upgrade time-critical targeting (TCT) capability and support transition to the warfighter. Completed 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. Designed and developed an autonomous multi-sensor management and data exploitation system supporting an all-weather mission for tactical platforms, including unmanned aerial vehicles (UAVs). Conducted critical experiments to investigate concealed target identification (ID) phenomenology. Conducted 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 unmanned aerial vehicles (UAV). 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)	In FY 2008: Continue spiral assessment and development of ATR/C, geo-registration, and change detection technology. Assessment of technology supporting Air Force TCT systems will occur in the Air Force ATR evaluation test facility. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected R&D and operational data sets. Perform interim demonstration and evaluation of concealed target ID sensing and exploitation technologies. Perform interim demonstration and evaluation of advanced tracking and multi-sensor track maintenance technology in a militarily significant scenario. Enhance ATR evaluation test facility and data sets to support TCT capabilities.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Determine need to continue spiral assessment and development of ATR/C, geo-registration and change detection technology. Continue assessment of technology supporting Air Force TCT occurring in the Air Force ATR evaluation test facility. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected R&D and operational data sets. Demonstrate TCT, advanced target tracking, and multi-sensor track maintenance capabilities. Enhance ATR evaluation test facility and data sets as required to support enhanced TCT capabilities. Determine technology shortfalls and develop emerging TCT and advanced target tracking technologies to overcome these shortfalls.				
(U)					
(U)	MAJOR THRUST: Develop Identify Friend, Foe, or Neutral (IFFN) air-to-ground capability using cooperative and non-cooperative identification techniques. Note: This work is an outgrowth of other work within this project.	1.889	2.890	2.878	2.026
(U)	In FY 2006: Conducted 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 included ground target database enhancements, advanced algorithms for non-cooperative ID of moving targets, and RF tags for cooperative target ID. Defined 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. Developed advanced algorithms to closely couple tracking with ID functions, exploit unique RF phenomenology, and integrate cooperative and non-cooperative ID methods. Assessed RF tag systems versus warfighter requirements to define a system architecture, defined techniques to assure secure data exchange without threat of exploitation, and defined interfaces for cross-service 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.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2008: Integrate and demonstrate improved ground target ID capabilities through enhanced target databases, ID algorithm advancements, and RF tags in a laboratory environment. Assess maturity of technology via a combination of exercises and scientific analysis by the Air Force ATR evaluation test facility. Initiate spiral assessment and development of IFFN air-to-ground capability enhancing test facilities and target databases as necessary. Plan operational exercise support.				
(U)	In FY 2009: Continue to integrate and demonstrate improved ground target ID capabilities through enhanced target databases, ID algorithm advancements, and RF tags in an operational environment. Assess performance of technology to support warfighter integration with operational systems. Continue refinement of ID algorithms and target databases as necessary to support transition of technology.				
(U)					
(U)	MAJOR THRUST: Develop wide angle, continuous staring, multi-sensor/multi-wavelength sensing, and automated exploitation technology that provides detection, tracking and identification of numerous objects of possible military significance over very large ground areas at sensor data update rates. Note: This work is an outgrowth of other work within this project.	0.000	0.000	5.000	5.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Design and breadboard the individual waveband sensors required to support the persistent staring and automated exploitation capability. Collect data required to support the development, testing and validation of the automated exploitation of the wide angle, continuous staring capability. Assess the maturity of the technology through scientific analyses conducted in the Air Force ATR component evaluation test facility.				
(U)	In FY 2009: Design and develop engineering model of the multi-sensor/multi-wavelength wide angle, continuous staring capability building upon the technologies developed during the individual component stage. Integrate and demonstrate wide angle, continuous staring component technologies. Assess the maturity of the technology via a combination of exercises and scientific analyses by the Air Force ATR evaluation test facility. Initiate spiral development of wide angle, continuous staring exploitation algorithms; phenomenological modeling; and target and scenario databases necessary to support transition to the warfighter.				
(U)					
(U)	MAJOR THRUST: Develop an advanced suite of sensors with ATR, fusion, and target tracking, all working in concert to provide a high confidence identification capability. Note: This work is an	0.000	0.000	0.000	8.718

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603203F Advanced Aerospace Sensors**	**69DF Target Attack and Recognition Technology**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	outgrowth of other work within this project.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Design and test an advanced aimpoint tracking capability. Develop and test ATR capability using EO sensor data. Build upon previous synthetic aperture radar (SAR) ATR capability to develop a high confidence exploitation of SAR data. Develop an advanced capability to fuse information and exploitation results from multiple sensors. Initiate spiral high confidence ID development of algorithm phenomenological modeling, target and scenario databases necessary to support technology development. Assess maturity of technology during the spiral process via the Air Force ATR test facility and sensor test facilities.				
(U)					
(U)	CONGRESSIONAL ADD: National Operational Signature Production and Research Capability (Combat Identification Signature Center).	5.011	1.295	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for National Operational Signature Production and Research Capability (Combat Identification Signature Center).				
(U)	In FY 2007: Conduct Congressionally-directed effort for National Operational Signature Production and Research Capability (Combat Identification Signature Center).				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	25.898	29.659	28.435	29.462

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

Space Technology.

(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 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
88SP Advanced Space Sensors	0.000	12.141	12.314	10.358	8.065	8.188	8.355	8.537	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transferred 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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Reduce technology risk for space sensor platform payload components and exploitation of infrastructure integration.	0.000	0.741	0.554	0.603
(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) In FY 2008: Develop approach to design responsive space payload capabilities while retaining hardware implementation feasibility. Define payload to bus satellite interface requirements and standards.				
(U) In FY 2009: Develop "plug-n-play" satellite critical experiment, to include full simulation.				
(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	1.145	1.859	1.871
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Develop space-based distributed position, navigation, and timing (PNT) technologies to detect, identify, and locate GPS threats. Develop multi-ship virtual flight test simulation technology to assess networked clusters of unmanned aerial vehicles (UAV), ISR platforms, and space-based platforms.				
(U) In FY 2008: Demonstrate space-based distributed PNT technologies to detect, identify, and locate GPS threats. Demonstrate multi-ship virtual flight test simulation technology to assess networked clusters of				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	UAVs, ISR platforms, and space-based platforms.				
(U)	In FY 2009: Design space-based distributed position, navigation, and timing technologies to achieve optimal sensor fusion for a Common Operational Picture (COP). Design multi-ship virtual flight test simulation technology to assess world-wide distributed PNT architectures for disparate platforms across the COP.				
(U)					
(U)	MAJOR THRUST: Develop electro-optical (EO) sensor component technology to advance multiple space mission areas. Develop new sensor components, topologies, and architectures for space.	0.000	1.675	1.683	1.229
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Fabricate advanced space environment phenomonology sensor components.				
(U)	In FY 2008: Conduct experimental space flight of sensor components to test in space environment. Initiate data collection, testing and system evaluation with relevant space environment phenomenology.				
(U)	In FY 2009: Complete experimental space flight of sensor components to test in space environment. Complete data collection, testing and system evaluation. Initiate lab-based integration testing with embedded satellite components.				
(U)					
(U)	MAJOR THRUST: Develop advanced laser communication component and sub-system technology to support a network-level topology for Airborne ISR.	0.000	5.000	6.349	5.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Begin development of an integrated wideband radio frequency (RF)/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 for RF, optical, and combined RF/optical communication terminals.				
(U)	In FY 2008: Continue development of an integrated wideband RF/EO communication terminal and shared aperture antenna. Begin evaluation and testing of the integrated terminal and antenna in an air network layer. Begin maturation of technologies for integration into communication architecture. Continue flight demonstrations of air network layer technologies for RF, optical, and combined RF/optical communication terminals.				
(U)	In FY 2009: Continue maturation of technologies for integration into communication architecture.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Continue multi-configuration flight demonstrations of air network layer technologies for RF, optical, and combined RF/optical communication terminals.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate geodesic phased array antenna (GDPAA) to achieve enhanced satellite operations over current reflector antennas. Improve operational capacity and efficiency to support satellite control network. Note: Increased emphasis on this effort in FY 2007 in order to accelerate program to meet the end user's timeline.	0.000	3.580	1.869	1.655
(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)	In FY 2008: Fabricate transmit/receive modules, radiating elements, beam former array panels for the GDPAA dome sub-sector to be used in the advanced technology demonstration (ATD).				
(U)	In FY 2009: Fully characterize the ATD sub-sector and demonstrate with operational satellites.				
(U)	Total Cost	0.000	12.141	12.314	10.358

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

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

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE
0603211F Aerospace Technology Dev/Demo

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	38.753	36.286	64.922	56.345	111.088	94.320	95.946	114.256	Continuing	TBD
486U	Advanced Aerospace Structures	9.226	7.372	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
4920	Flight Vehicle Tech Integration	29.527	26.125	64.922	56.345	111.088	94.320	95.946	114.256	Continuing	TBD
99SP	Advanced Structures Space Vehicles	0.000	2.789	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2006, efforts from Project 486U transfered into Project 4920 within this PE. Funds for the FY 2006 Congressionally-directed Design Manual for Titanium Honeycomb Sandwich Composite in the amount of $3.253 million were 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. Funds for the FY 2007 Congressionally-directed Short Take Off and Landing Herk 1 Continuation in the amount of $1.594 were moved into PE 0603211F, Aerospace Technology Dev/Demo, from PE 0401115F, C-130 Airlift Squadron, for execution.

(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 2007, Congress added $1.0 million for 3-D Woven/Braided Composites, $1.0 million for the Advanced Aerospace Titanium Structures (AATS) Initiative, $1.0 million for the Advanced Aluminum Aerostructures Initiative (A3I), $1.3 million for Large Composite Affordable Composite Structures, $1.7 million for the National Capabilities Analysis Collaborative, Phase 3, $1.1 million for Titanium Honeycomb Sandwich and Composite Structures, and $1.6 million for Short Take Off and Landing (STOL) Herk 1 Continuation. 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 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603211F Aerospace Technology Dev/Demo**

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

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	53.657	27.424	57.925	114.655
(U)	Current PBR/President's Budget	38.753	36.286	64.922	56.345
(U)	Total Adjustments	-14.904			
(U)	Congressional Program Reductions				
	Congressional Rescissions	0.280	-0.138		
	Congressional Increases		31.100		
	Reprogrammings	-14.327	-22.100		
	SBIR/STTR Transfer	-0.857			

(U) Significant Program Changes:

FY 2006 changes are the result of moving Congressionally-directed efforts from this PE to the proper PEs for execution and increased emphasis being placed on improving lift and performance capability of manned and unmanned platforms in Project 4920 within this PE.

FY 2007 changes are the result of moving Congressionally-directed efforts from this PE to the proper PEs for execution.

(U) C. Performance Metrics

Under Development

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
486U Advanced Aerospace Structures	9.226	7.372	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	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 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 2006	FY 2007	FY 2008	FY 2009
(U) CONGRESSIONAL ADD: Design Manual for Titanium Honeycomb Sandwich Composite Structure.	3.172	1.096	0.000	0.000
(U) In FY 2006: Initiated Congressionally-directed effort for design manual for titanium honeycomb sandwich composite structure.				
(U) In FY 2007: Continued Congressionally-directed effort for design manual for titanium honeycomb sandwich composite structure.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Fly-By-Light.	2.018	0.000	0.000	0.000
(U) In FY 2006: Continued Congressionally-directed effort for fly-by-light.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Wright Brothers Institute - Capabilities Analysis Phase 2.	4.036	1.694	0.000	0.000
(U) In FY 2006: Continued Congressionally-directed effort for capabilities planning support.				
(U) In FY 2007: Continued Congressionally-directed effort for capabilities planning support.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603211F Aerospace Technology Dev/Demo**	PROJECT NUMBER AND TITLE **486U Advanced Aerospace Structures**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)					
(U)	CONGRESSIONAL ADD: 3-D Woven/Braided Composites	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable				
(U)	In FY 2007: Initiated Congressionally-directed effort for 3-D woven/braided composites.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Aerospace Titanium Structures (AATS) Initiative.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable				
(U)	In FY 2007: Initiated Congressionally-directed AATS effort.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Aluminum Aerostructures (A3I) Initiative.	0.000	1.295	0.000	0.000
(U)	In FY 2006: Not Applicable				
(U)	In FY 2007: Continued Congressionally-directed A3I effort, last funded by Congress in FY 2005.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Large Scale Affordable Composite Structures	0.000	1.295	0.000	0.000
(U)	In FY 2006: Not Applicable				
(U)	In FY 2007: Initiated Congressionally-directed effort for large-scale affordable composite structures.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	Total Cost	9.226	7.372	0.000	0.000

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602201F, Aerospace										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) C. Other Program Funding Summary ($ in Millions)

Vehicle Technologies.

(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 2007

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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4920 Flight Vehicle Tech Integration	29.527	26.125	64.922	56.345	111.088	94.320	95.946	114.256	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2006, efforts from Project 486U transferred 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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop autonomous flight controls for safe flight and cooperative operations between manned and unmanned air platforms. Note: The FY 2009 increase in funding is due to the demonstration efforts related to automated situational awareness for unmanned air systems.	7.601	5.239	6.379	14.411

(U) In FY 2006: Completed 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. Completed environmental testing of key photonic sensing and control elements for flight critical control. Prepared key photonic sensing and control elements for flight-testing. Flight demonstrated 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 air base ground operations for unmanned air vehicles.

(U) In FY 2008: Further develop situational awareness and control technologies for automated air base ground operations for unmanned air vehicles. Incorporate electromagnetic threat tolerant control systems technologies for air base ground operations for unmanned air vehicles.

(U) In FY 2009: Conduct ground demonstrations of situational awareness and control technologies for automated air base ground operations for unmanned air vehicles. Develop and demonstrate cooperative teaming of small unmanned air vehicles in complex, low altitude environments. Conduct evaluation of validation and verification tools and process for affordable certification of autonomous unmanned air vehicle flight control software. Refine development efforts for electromagnetic threat tolerant control

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	systems technologies for air base ground operations for unmanned air vehicles.				
(U)					
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop, simulate, and demonstrate integrated technologies to improve the performance of manned and unmanned platforms. Note: The FY 2007, decrease is due to completion of a majority of the thrust objectives in FY 2006. In FY 2008, increased emphasis being placed on demonstration efforts related to the composite affordability initiative.	10.388	3.037	41.349	17.342
(U)	In FY 2006: Completed initial demonstration of an actively controlled conformal inlet system for increased propulsion system performance for unmanned air vehicles. Continued 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. Initiated Short Take Off and Landing (STOL) Herk 1 efforts to improve lift and performance capability of the AC-130 gunships.				
(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. Continue Congressionally-directed efforts for STOL Herk 1.				
(U)	In FY 2008: Conduct flight demonstration of extensive laminar flow on swept wing test article. Complete wind tunnel testing of gust load alleviation and body freedom flutter suppression of high altitude, long endurance platforms. Complete integration of data streams and analysis tools; graphical user interfaces; database/model updates; validation of model and selection criteria; and identification of model correction factors. Develop and integrate aircraft components that capitalize upon unitized advanced materials that are lightweight and affordable into an X-type cargo aircraft. Develop approaches that would reduce the tooling required to fabricate aircraft components. Begin flight demonstration efforts for an X-type cargo aircraft.				
(U)	In FY 2009: Complete flight demonstration of extensive laminar flow on swept wing test article. Conduct and complete flight demonstration of an X-type aircraft comprised of advanced materials for weight reduction, surface smoothness, corrosion, and fatigue elimination.				
(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: In FY 2008, the	3.475	8.614	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	demonstration efforts real-time diagnostic and prognostics health monitoring demonstration efforts are being suspended because of the need for additional Applied Research efforts.				
(U)	In FY 2006: Continued development and initiated 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. Continued development and initiated 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop aircraft structures that have embedded components, which have previously been separate components that were attached to the air platforms. Note: The FY 2008 and out year increase in funding is due to the demonstration efforts related to flight testing of large X band antenna embedded in a load bearing structure.	4.378	6.170	14.125	20.766
(U)	In FY 2006: Continued development of multi-functional integrated structures to reduce acquisition and support costs, weight, and volume and increase performance of air vehicles. Initiated 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. Continued development and initiated 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.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Complete structural demonstration of low band antenna structure. Asses and refine development of multi-functional integrated structures to reduce cost, weight, while improving performance of future air platforms. Complete fabrication and flight test a large X band electronically-scanned antenna array embedded in a load-bearing structure.				
(U)	In FY 2009: Complete and assess test results from the flight demonstration of the large X band electronically scanned antenna array embedded in a load-bearing structure.				
(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.	3.685	3.065	3.069	3.826
(U)	In FY 2006: Continued development and initiated 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. Continued development and initiated+ demonstration of highly efficient wing concepts integrating active aero elastic 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 aero elastic design concepts, adaptive structures, and aerodynamic flow control technologies to enable viable long range and long endurance air vehicle concepts.				
(U)	In FY 2008: Develop passive and active leading edge cooling systems for ultra, high-speed vehicles. Develop and validate integration methodologies for component level leading edge test articles. Complete development and demonstration of highly efficient wing concepts integrating active aero elastic design concepts.				
(U)	In FY 2009: Demonstrate passive and active thermal protection systems for leading edge components. Assess results from demonstrations of advanced efficient wings concepts integrating active aeroelastic design concepts and adaptive structures.				
(U)					
(U)	Total Cost	29.527	26.125	64.922	56.345

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) C. Other Program Funding Summary ($ in Millions)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603211F Aerospace Technology Dev/Demo**	**99SP Advanced Structures Space Vehicles**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
99SP	Advanced Structures Space Vehicles	0.000	2.789	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	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. In FY 2008, the remaining efforts in Project 6399SP were transferred into Project 4920 within this PE, as the planned efforts were not space unique.

(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 2006	FY 2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Develop the airframe and payload technologies required to enable horizontal launch of reusable high altitude aerospace vehicles.	0.000	2.789	0.000	0.000
(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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	Total Cost	0.000	2.789	0.000	0.000

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	PE 0602201F, Aerospace Vehicle Technology										
(U)	This project has been coordinated through the										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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

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

Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Acquisition Strategy**

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE
0603216F Aerospace Propulsion and Power Technology

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	98.901	145.891	117.990	163.066	204.549	189.899	128.513	131.258	Continuing	TBD
10SP	Space Rocket Prop Demo	0.000	27.753	27.905	31.536	39.889	40.680	38.439	38.835	0.000	0.000
2480	Aerospace Fuels	5.187	9.432	7.524	12.177	12.658	10.776	8.523	8.654	Continuing	TBD
3035	Aerospace Power Technology	8.391	14.198	5.975	4.496	4.664	4.742	4.843	4.961	Continuing	TBD
4921	Aircraft Propulsion Subsystems Int	31.996	27.729	16.459	31.950	43.207	55.598	18.555	19.146	Continuing	TBD
4922	Space & Missile Rocket Propulsion	7.713	4.821	4.734	5.138	5.331	5.422	5.535	5.673	Continuing	TBD
5098	Advanced Aerospace Propulsion	22.187	34.036	21.886	23.233	24.606	24.513	23.567	24.125	Continuing	TBD
681B	Advanced Turbine Engine Gas Generator	23.427	27.922	33.507	54.536	74.194	48.168	29.051	29.864	Continuing	TBD

Note: In FY 2006-2007, a portion of the funding in Projects 2480 and 4921 was shifted to Project 5098. In FY 2007, Project 10SP, Space Rocket Propulsion Demonstration, was transferred 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. The funding in this PE has been increased due to emphasis on component development in support of adaptive cycle technologies, alternative hydrocarbon jet fuel, improved fuel efficiency, highly efficient embedded turbine engines, and small heavy fueled engines.

(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 electrical power thermal management, and fuels. The program has seven 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 management 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 (APSI) 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 Versatile Affordable Advanced Turbine Engine program. A portion of the Fuels, ATEGG, and APSI projects supports adaptive cycle technology demonstrations which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs. 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). The Space and Missile Rocket Technology project develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques. The Space and Rocket Propulsion Demonstration 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. Rocket propulsion projects within this program are part of the Integrated High Payoff Rocket

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603216F Aerospace Propulsion and Power Technology**

Propulsion Technology (IHPRPT) program, which includes the area of Technology for the Sustainment of Strategic Systems. Note: In FY 2007, Congress added $4.6 million for Assured Fuels Process Demonstration Unit; $2.0 million for Flexible JP-8 Military Fuel Certification; $1.0 million for Development of Bi-Polar Wafer-Cell Ni-MH Battery; $1.0 million for Field Renewable Energy System Hydride Li Ion Battery Program; $6.6 million for Silicon Carbide Power Electronics for More Electric Aircraft; $5.5 million for Accelerated VAATE Adv Supersonic Cruise Missile Engine; $8.0 million for XTC58F Technology Versatile Affordable Advanced Turbine Engine Program; and $2.2 million for Versatile Affordable Advanced Turbine Engines. 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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	97.163	115.546	119.310	128.770
(U)	Current PBR/President's Budget	98.901	145.891	117.990	163.066
(U)	Total Adjustments	1.738			
(U)	Congressional Program Reductions		-0.002		
	Congressional Rescissions	-0.003	-0.553		
	Congressional Increases		32.900		
	Reprogrammings	4.117	-2.000		
	SBIR/STTR Transfer	-2.376			

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603216F Aerospace Propulsion and Power Technology**	**10SP Space Rocket Prop Demo**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
10SP Space Rocket Prop Demo	0.000	27.753	27.905	31.536	39.889	40.680	38.439	38.835	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transferred 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 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 technologies for station-keeping and on-orbit maneuvering applications. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion technologies, 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 payload capabilities by approximately 20 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.

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch vehicles.	0.000	21.202	22.486	25.877
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Completed testing of advanced lightweight thrust chamber and nozzle technologies. Scaled-up advanced cryogenic upper stage technologies including higher efficiency energy conversion systems. Completed hardware design for advanced cryogenic upper stage technologies - turbopumps and thrust chambers. Studied advanced hydrocarbon engine technologies for future reusable launch vehicles.				
(U)	In FY 2008: Begin hardware fabrication for advanced cryogenic upper stage technologies - turbopumps and thrust chambers. These components will be used to validate modeling, simulation, and analysis tools being developed. Begin preparations for testing of these components. Start component and engine designs for advanced hydrocarbon engine technologies for future reusable launch vehicles. Initiate an				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	advanced manufacturing technology demo aimed at materials and processes to support the hydrocarbon engine technology development effort. Initiate advanced hydrocarbon fuels scale-up effort to prove out advanced hydrocarbons as fuels or additives to rocket engine fuels and for potential use in future reusable launch vehicles.				
(U)	In FY 2009: Complete advanced cryogenic upper stage hardware fabrication and begin testing components to validate and verify modeling and simulation tools developed. Develop hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept for future reusable launch vehicles. Continue material manufacturing scale-up effort to support hydrocarbon boost demonstration program. Continue advanced hydrocarbon fuel/additive scale-up and proof efforts.				
(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	5.354	4.345	3.787
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Continue development of electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of Low Earth Orbit to Geosynchronous Orbit transfer. Begin component integration for the high-power Hall thruster demonstration. Complete test flight of the advanced small satellite propulsion demonstration unit for a microsatellite demonstration. Support test flight of propulsive attitude control system on microsatellite demonstration. Initiate hardware scale-up for an advanced multi-mode (high thrust or high efficiency) propulsion system for satellites. Continue development of satellite sensors to analyze satellite thruster interactions.				
(U)	In FY 2008: Continue development of electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of Low Earth Orbit to Geosynchronous Orbit transfer. Continue component integration for the high-power Hall thruster demonstration. Continue hardware scale-up for an advanced multi-mode (high thrust or high efficiency) propulsion system for satellites. Complete development of satellite sensors to analyze satellite thruster interactions.				
(U)	In FY2009: Continue development of electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of Low Earth Orbit to Geosynchronous Orbit transfer. Conduct and complete testing of the high-power Hall thruster demonstration. Continue hardware scale-up for an advanced multi-mode (high thrust or high efficiency) propulsion system for satellites. Continue demonstration of advanced chemical propulsion system for satellites.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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	1.197	1.074	1.872
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Initiate development of an advanced Phase III monopropellant thruster and complete development of Phase II monopropellant thruster technologies.				
(U)	In FY 2008: Continue development of an advanced Phase III monopropellant thruster.				
(U)	In FY 2009: Continue development of an advanced Phase III monopropellant thruster technologies.				
(U)	Total Cost	0.000	27.753	27.905	31.536

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Not Applicable.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603216F Aerospace Propulsion and Power Technology**	**2480 Aerospace Fuels**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2480 Aerospace Fuels	5.187	9.432	7.524	12.177	12.658	10.776	8.523	8.654	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: The funding in this project has been increased due to emphasis on component development in support of adaptive cycle technologies, alternative hydrocarbon jet fuel, and improved fuel efficiency.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates improved hydrocarbon fuels and advanced, novel aerospace propulsion technologies, including technologies 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. A portion of this project supports the demonstration of adaptive cycle technologies. This project develops component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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. Identify, develop, and demonstrate technologies that enable the use of domestic fuel sources for military energy needs. Determine fuel cooling requirements and specifications for an adaptive cycle engine architecture. Design, fabricate, and test key thermal management technologies, including high heat sink fuels, cooled cooling air systems, and high temperature/thermally efficient fuel pumps for mission adaptive engines. Note: In FY 2006 and FY 2007, funding from this Project was moved to support higher Air Force priorities in Project 5098, Advanced Aerospace Propulsion, in this PE. Funding shift caused delay in development of this effort. Increased funding in FY2008 and out due to emphasis on component development in support of alternative hydrocarbon jet fuel. Increased funding in FY 2009 and out due to emphasis on component development in support of adaptive cycle technologies.	0.025	1.000	4.000	6.994
(U) In FY 2006: Studied, tested, and demonstrated 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	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)	In FY 2008: Continue demonstrations of fuel combustion performance at fuel temperatures in the supercritical regime, as might be encountered in an engine employing a cooled cooling air system. Demonstrate engine durability benefits from the use of alternative fuels. Develop relationship between alternate fuel composition and key properties, including low temperature viscosity and thermal/storage stability. Improve physical property models for alternative fuels. Develop relationship between fuel/material interactions and fuel (and material) structure.				
(U)	In FY 2009: Continue demonstration of engine and airframe durability and performance benefits from the use of alternative fuels. Continue development of knowledge base needed for Air Force-wide certification of alternative fuels, especially biofuels. Continue demonstration of cooled cooling air systems and other advanced aircraft thermal management systems. Determine fuel structure changes required to increase specific gravity to 0.775. Determine elastomer swell agents capable of increasing swell to typical JP-8 levels. Begin determination of new specification requirements for biomass-derived alternative fuels. Develop key thermal management technologies, including high heat sink fuels, cooled cooling air systems, and high temperature/thermally efficient fuel pumps.				
(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). Note: In FY 2006 and FY 2007, funding from this Project was moved to support higher Air Force priorities in Project 5098, Advanced Aerospace Propulsion, in this PE. Funding shift caused delay in development of this effort.	0.025	0.506	1.000	2.000
(U)	In FY 2006: Studied, tested, and demonstrated at a pilot-light level 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)	In FY 2008: Continue to demonstrate advanced low temperature and enhanced performance fuels for UAV applications and the Highly Efficient Embedded Turbine Engine (HEETE), focusing on advanced				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	thermal management technologies that expand the flight envelope, range, or duration of UAVs.				
(U)	In FY 2009: Demonstrate an advanced UAV/HEETE thermal management system that includes a cooled cooling air system, as well as advanced approaches for ensuring fuel flow in wing tanks under high altitude, long endurance conditions.				
(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. Note: In FY 2006 and FY 2007, funding from this Project was moved to support higher Air Force priorities in Project 5098, Advanced Aerospace Propulsion, in this PE. Funding shift caused delay in development of this effort.	0.025	0.506	1.000	1.183
(U)	In FY 2006: Demonstrated at a pilot-light level fuel 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)	In FY 2008: Demonstrate advanced particulate measurement diagnostics suitable for full-scale engine testing. Initiate demonstration of fuel/combustor concepts that reduce both soot and NOx.				
(U)	In FY 2009: Continue to demonstrate advanced particulate measurement diagnostics suitable for full-scale engine testing. Continue demonstration of fuel/combustor concepts that reduce both soot and NOx.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate enhancements to fuel system technology. Note: In FY 2006 and FY 2007, funding from this Project was moved to support higher Air Force priorities in Project 5098, Advanced Aerospace Propulsion, in this PE. Funding shift caused delay in development of this effort.	0.025	0.340	1.000	1.000
(U)	In FY 2006: Designed and developed at a pilot-light level 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)	In FY 2008: Develop combined cycle engine cooling systems, utilizing 2nd-generation endothermic				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	fuels and other advanced fuels.				
(U)	In FY 2009: Continue development and demonstration of combined cycle engine cooling systems and technologies utilizing 2nd-generation endothermic fuels and other advanced fuels.				
(U)					
(U)	MAJOR THRUST: Identify, develop, and demonstrate low-cost approaches to reducing the fuel logistics footprint for the Expeditionary Air Force. Note: In FY 2006 and FY 2007, funding from this Project was moved to support higher Air Force priorities in Project 5098, Advanced Aerospace Propulsion, in this PE. Funding shift caused delay in development of this effort.	0.087	0.505	0.524	1.000
(U)	In FY 2006: Developed at a pilot-light level 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 detection and mitigation technologies for biological growth.				
(U)	In FY 2008: Develop model for growth and spread of biological materials through fuel handling systems. Continue to demonstrate advanced nano-technology fuel additives, nano-technology fuel sensors, and novel detection and mitigation technologies for biological growth.				
(U)	In FY 2009: Develop ability to model spread of biological materials through fuel handling systems. Initiate demonstration of advanced additives to mitigate biological growth in conventional and alternative aerospace fuels.				
(U)					
(U)	MAJOR THRUST: Characterize and demonstrate the use of alternative hydrocarbon jet fuel to comply with Air Force certifications and standards for jet fuels. Note: Funding increase in FY 2006 only due to emphasis on component development in support of alternative hydrocarbon jet fuel.	5.000	0.000	0.000	0.000
(U)	In FY 2006: Demonstration of alternative hydrocarbon jet fuel derived from natural gas via the Fischer-Tropsch (FT) process. This is a blend of conventional JP-8 and FT alternative fuel, which went through material testing, engine ground testing, and flight testing in two of eight engines in a B-52.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Assured Fuels Process Demonstration Unit.	0.000	4.583	0.000	0.000
(U)	In FY 2006: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification

DATE	
February 2007	

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603216F Aerospace Propulsion and Power Technology**	**2480 Aerospace Fuels**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2007: Develop capability to investigate relationship between alternative jet fuel production processes and resulting fuel properties. Research effects of feedstock (coal, biomass, etc.) on resulting jet fuel properties.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Flexible JP-8 Military Fuel Certification.	0.000	1.992	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Support development of lean process for certifying non-petroleum-derived jet fuels for Air Force systems. Procure and test non-petroleum fuels as required for certification.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	5.187	9.432	7.524	12.177

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603216F Aerospace Propulsion and Power Technology**	**3035 Aerospace Power Technology**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3035 Aerospace Power Technology	8.391	14.198	5.975	4.496	4.664	4.742	4.843	4.961	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates electrical power, thermal management, and distribution 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 electrical power and thermal management technologies to enable solid state high power density sources for directed energy weapons.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop electrical power and thermal management component subsystem technologies for integration 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 begin transition to a separate effort in this Project, closing out this activity in FY 2009.	0.929	0.917	0.214	0.000
(U) In FY 2006: Developed technology roadmaps and completed analysis of power system integration into an airframe as part of a non-lethal weapon system. Completed initial design of 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) In FY 2008: Perform test of high power megawatt class low duty cycle power generation technology.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) MAJOR THRUST: Develop power generation/conditioning/distribution component, energy storage, and thermal management components and subsystem technologies for integration into current and future high power aircraft. These technologies will improve aircraft self-sufficiency, reliability, maintainability, supportability, and system weight/volume ratios, while reducing life cycle costs and enabling new capabilities. Note: In FY 2006, activities were completed, with follow-on efforts starting again in FY 2009.	1.190	0.000	0.000	1.450
(U) In FY 2006: Completed engine integration and test of the internal starter generator in mid-thrust class engines.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Begin design of high temperature demonstrator and fabrication of key components.				
(U)					
(U)	MAJOR THRUST: Develop electrical power and thermal management components and subsystem technologies for special purpose applications. Note: In FY 2006, funding for this thrust was shifted within this Project to support multi-megawatt superconducting activities. Efforts within this thrust were delayed until FY 2007. In FY 2008, this activity will be completed.	0.000	1.442	2.273	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Investigate alternative energy storage/generation systems for low power applications.				
(U)	In FY 2008: Develop and fabricate high power density and high energy density fuel cell and battery energy storage and power and thermal management/distribution components and subsystems. Deliver for field tests to demonstrate a 50% weight reduction.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop analytical tools and subsystems for multi-megawatt superconducting electrical power systems including power generation, conditioning, thermal management, and dynamic interaction.	1.656	3.272	3.488	3.046
(U)	In FY 2006: Completed preliminary design for a megawatt class power demonstrator.				
(U)	In FY 2007: Begin detailed design of megawatt class power demonstrator and begin fabrication of key components.				
(U)	In FY 2008: Design and fabricate multi-megawatt superconducting power and thermal management components.				
(U)	In FY 2009: Integrate and begin demonstration testing of multi-megawatt superconducting power and thermal management.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Satellite Thermal Control Program.	1.635	0.000	0.000	0.000
(U)	In FY 2006: Developed electrochromic coatings (EC's) and prepared 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)	In FY 2008: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: More Electric Technology for Mission Critical Power Systems.	2.019	0.000	0.000	0.000
(U)	In FY 2006: Selected near-term and far-term applications and then developed flightweight hardware, durability testing, and preliminary testing that could lead to eventual military qualification.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Field Renewable Energy System Hybrids (FRESH) Li Ion Battery Program.	0.962	0.996	0.000	0.000
(U)	In FY 2006: Developed rechargeable batteries for the 12V applications of the Battlefield Renewable Integrated Tactical Energy System program.				
(U)	In FY 2007: Continue the development of Li-Ion battery powered field renewable energy systems.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Development of Bi-Polar Wafer-cell NI-MH battery.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Evaluate the viability of advanced nickel-metal hydride battery technology to provide an environmental minimum/no maintenance replacement for existing vented nickel-cadmium and valve regulated lead-acid batteries for military aircraft applications.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Silicon Carbide (SiC) Power Electronics for More Electric Aircraft.	0.000	6.575	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Extend the present state-of-the-art on 600V, bias-enhanced, power junction field effect transistor (JFET) technologies. Evaluate new device physics, device designs, and device fabrication technology to continue the development of low specific on-resistance power JFET and rectifier devices.				
(U)	In FY 2008: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	8.391	14.198	5.975	4.496

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603216F Aerospace Propulsion and Power Technology**	**4921 Aircraft Propulsion Subsystems Int**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4921	Aircraft Propulsion Subsystems Int	31.996	27.729	16.459	31.950	43.207	55.598	18.555	19.146	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: The funding in this project has been increased due to emphasis on component development in support of adaptive cycle technologies.

(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 Propulsion Safety And Readiness (PSAR) program. This project also focuses on 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 Versatile Affordable Advanced Turbine Engine (VAATE) program, which is focused on improving propulsion capabilities while at the same time reducing the cost of ownership. Anticipated technology advances include turbine engine improvements providing approximately twice the range for a sustained supersonic combat aircraft, doubling the time on station with 10 times the power output for surveillance aircraft, and propulsion for a high speed supersonic missile with double the range for time sensitive targets. The VAATE program provides 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. A portion of this project supports the demonstration of adaptive cycle technologies, which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs.

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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.	1.455	1.315	0.825	1.259
(U)	In FY 2006: Designed and developed 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 agile combat support engine technologies to increase durability of components to include advanced aerodynamics for fans, turbines, mechanical systems, interactions between the inlet				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	and fan, and controls/accessories.				
(U)	In FY 2008: Begin testing 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 2009: Complete testing and begin validation of engine life models for engine components for agile combat support technologies. Initiate design of advanced features for durable fans, turbines, mechanical systems, interactions between the inlet and fan, and controls/accessories.				
(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, surveillance aircraft 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. Design, fabricate, and test advanced component technologies for improved performance, fuel consumption, durability and cost for mission adaptive engines in full-engine environments. Note: In FY 2009, increased funding is for final assembly and substantial testing that will begin on large demonstrator engines. The funding in this effort has been increased in FY 2009 and out due to emphasis on component development in support of adaptive cycle technologies.	10.834	9.086	8.945	25.885
(U)	In FY 2006: Completed fabrication and testing of the multi-property rotor, fluidic control, and modulated turbine cooling. Designed advanced lightweight engine concept (utilizes a hollow fan, radial compressor, and low profile combustor) capable of operating as primary propulsion or in a lift mode. Initiated advanced engine designs for a sustained supersonic engine using variable cycle features, an advanced fan, improved turbine using cooled metal and cooled ceramic matrix composites (CMCs), and lightweight CMC cases and ducts.				
(U)	In FY 2007: Enhance advanced designs and begin fabrication and testing for lightweight high bypass engine (utilizes a hollow fan and radial compressor) 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)	In FY 2008: Finish testing of lightweight high bypass engine components (utilizes a hollow fan and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	radial compressor) capable of operating as primary propulsion or in a lift mode. Begin fabrication and assembly of advanced engine designs for a supersonic engine using variable cycle features, advanced fan, improved turbine using cooled metal and cooled CMCs, advanced augmentor, and lightweight CMC cases and ducts.				
(U)	In FY 2009: Finish assembly and begin testing of engine designs for a supersonic and subsonic engine using variable cycle features, an advanced fan, improved turbine using cooled metal and cooled CMCs, advanced augmentor, and lightweight CMC cases and ducts. Initiate design of high bypass ultra fuel efficient engine. Begin preliminary design of advanced adaptive cycle (third air stream) engine technologies, including an advanced fan, high work low turbine for long dwell time, controls, inlet integration, and advanced exhaust nozzle for sustained supersonic flight vehicle.				
(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.	5.258	3.879	6.689	4.806
(U)	In FY 2006: Designed and fabricated advanced high temperature cooled turbine blade and combustor for UAV applications. Designed 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)	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 for missile applications.				
(U)	In FY 2008: Finish fabrication of engine components of advanced high temperature cooled turbine blade and combustor for UAV applications. Finish fabrication and begin assembly of advanced components for technologies for engine testing to include an advanced lightweight fan/compressor, turbines with new advanced cooling approaches, oil-less bearings and high through flow combustors for missile applications.				
(U)	In FY 2009: Begin testing of advanced components for technologies for engine testing to include an advanced light weight fan/compressor, turbines with new advanced cooling approaches, oil-less bearings and high thru flow combustors for missile applications. Initiate design of low cost high mach fuel efficient engine for improved range. Initiate design of a higher specific thrust high mach expendable				

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	turbine engine for improved fuel efficiency improving range. Initiate low spool components for fuel efficient subsonic unmanned turbofan engine.				
(U)					
(U)	CONGRESSIONAL ADD: Versatile Affordable Advanced Turbine Engine - 5K-7K Thrust Category.	1.154	0.000	0.000	0.000
(U)	In FY 2006: Conducted system studies for the multi-purpose core and associated design activities to extend its applicability to engines in the 5,000 to 7,000 pound turbofan thrust class.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: X-43C Development.	0.986	0.000	0.000	0.000
(U)	In FY 2006: Designed combined cycle engine propulsion systems for potential low-cost flight demonstration under X-43C. System design options include legacy X-43C, X-51 derivative, and other research flight test configurations. Combined cycle engine propulsion system combines scramjet engines with high-speed turbine and/or rocket engines. The turbine, rocket and scramjet engine components include technology elements traceable to full-scale vision concepts. The performance of the combined cycle engine propulsion system was 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: XTC58F Technology Versatile Affordable Advanced Turbine Engine Program (Note: Only for the XTC 58F/1 demonstrator program). This Add was previously titled Versatile Affordable Advanced Turbine Engine.	6.539	7.970	0.000	0.000
(U)	In FY 2006: Updated the preliminary design and configuration of the common core by incorporating changes necessary to accommodate both UAV and heavy lift applications. Created detailed design of advanced component technologies for UAV applications.				
(U)	In FY 2007 Establish a conceptual design of a highly efficient embedded turbine engine based around the small turbofan core. Design and evaluate a high pressure compressor rig; improved bearings, improved seals, and thermal barrier coating for the high pressure turbine. Assess integration issues such				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	as incorporation of a variable exhaust nozzle.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Acceleration VAATE Advanced Supersonic Cruise Missile Engine (formerly VAATE Advanced Supersonic Cruise Missile Engine).	5.770	5.479	0.000	0.000
(U)	In FY 2006: Performed risk reduction rig designs for the turbine, afterburner, and nozzle components. Conducted testing of the rigs when fabrication was completed and developed fabrication process of a cast blisk turbine utilizing an advanced cooling concept.				
(U)	In FY 2007: Continue to define and develop Long Range Strike Mach 4+ expendable turbine engine technologies.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	Total Cost	31.996	27.729	16.459	31.950

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603216F Aerospace Propulsion and Power Technology**	**4922 Space & Missile Rocket Propulsion**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4922	Space & Missile Rocket Propulsion	7.713	4.821	4.734	5.138	5.331	5.422	5.535	5.673	Continuing	TBD
	Quantity of RDT&E Articles	0	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 25 percent (Phase I)/35 percent (Phase II) and reduce hardware and operation costs by approximately 25 percent (Phase I)/35 percent (Phase II). Aging and Surveillance efforts could reduce lifetime prediction uncertainties for individual motors by 50 percent, enabling motor replacement for cause. 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.

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Develop and demonstrate missile propulsion and Post Boost Control Systems (PBCS) technologies for ballistic missiles. Note: In FY 2007, efforts within this thrust will be completed following the Missile Propulsion Demonstration.	2.152	3.768	0.000	0.000
(U)	In FY 2006: Developed hardware 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(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. In FY 2008 and FY 2009, funding increase supports build up and testing in a significant full scale Missile Propulsion demonstration.	3.737	0.587	3.011	3.970
(U)	In FY 2006: Developed the necessary modeling and simulation tools (Phase II) for analyzing and development of missile components.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2007: Complete modeling and simulation tools (Phase II) development for analyzing and developing missile components. 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)	In FY 2008: Continue 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)	In FY 2009: Complete sub-scale component developments providing sub-scale validation of modeling and simulation tools. Initiate full-scale demonstration of advanced missile propulsion components, advanced solid propellants, and advanced modeling and simulation tools.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate aging and surveillance technologies for strategic systems to reduce lifetime prediction uncertainties for individual motors by 50%, enabling motor replacement for cause. 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.	0.381	0.466	1.723	1.168
(U)	In FY 2006: Developed the necessary aging and surveillance tools for predicting the health of solid rocket motors and methods. Applied 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)	In FY 2008: Continue 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)	In FY 2009: Begin full-scale demonstration of advanced aging and surveillance tools for solid rocket motors to validate and verify modeling and simulation tools and component technologies.				
(U)					
(U)	CONGRESSIONAL ADD: Solid Boost Power Technology.	1.443	0.000	0.000	0.000
(U)	In FY 2006: Conducted 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)	In FY 2008: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	7.713	4.821	4.734	5.138

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0602102F, Materials.										
(U)	PE 0602203F, Aerospace Propulsion.										
(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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5098	Advanced Aerospace Propulsion	22.187	34.036	21.886	23.233	24.606	24.513	23.567	24.125	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 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 for possible application 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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop and demonstrate technologies for a hydrocarbon-fueled scramjet with robust operation over a range of Mach 4 to 8.	22.187	34.036	21.886	23.233
(U) In FY 2006: Performed detailed design of the scramjet engine demonstrator air vehicle. Completed vehicle subsystem trade studies and designs for structures, avionics, instrumentation, booster, and other necessary technologies. Conducted multiple risk reduction tests and analyses to reduce both aerodynamic and propulsion uncertainties prior to Critical Design Review. Conducted extensive transonic, supersonic, and hypersonic wind tunnel tests and simultaneously conduct computational fluid dynamics analyses of tested configurations. Conducted aero-thermodynamic analyses 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) In FY 2008: Complete fabrication of air vehicle flight hardware and finalize flight test preparations at supporting test centers (Air Force Flight Test Center and Point Mugu Test Center).				
(U) In FY 2009: Conduct integrated air vehicle/propulsion flight tests and conduct post test data reduction				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	and reporting.				
(U)	Total Cost	22.187	34.036	21.886	23.233

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable

Exhibit R-2a, RDT&E Project Justification

DATE
February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603216F Aerospace Propulsion and Power Technology**	**681B Advanced Turbine Engine Gas Generator**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
681B	Advanced Turbine Engine Gas Generator	23.427	27.922	33.507	54.536	74.194	48.168	29.051	29.864	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: The funding in this project has been increased in FY 2008 and out due to emphasis on component development in support of adaptive cycle demonstrations, highly efficient embedded turbine engines, and small heavy fueled engines.

(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 demonstration validates engineering design tools and 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). 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 in "core-centric engine" demonstration. The core performances of this project are validated on demonstrator engines in Project 4921 of this PE. Efforts are part of the Versatile Affordable Advanced Turbine Engines (VAATE) program. A portion of this project supports the demonstration of adaptive cycle technologies, which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Design, fabricate, and demonstrate performance predictions in 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 combined cycle 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 for long range strike capability.	21.455	22.183	21.422	42.031
(U) In FY 2006: Completed preliminary design and began 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	active control, thermal management, and power extraction. Created preliminary design and risk reduction planning for a tip turbine concept, including a novel compression system, innovative annular combustor, and advanced rotating seals. Explored 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)	In FY 2008: Complete fabrication and initiate instrumentation and assembly of advanced core engine components, 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 detailed design and initiate fabrication for a tip turbine concept, including a novel compression system, innovative annular combustor, and advanced rotating seals. Complete design and fabrication of unique compression system components. Initiate preliminary design of high temperature capable, durable compressor, combustor, and turbine for sustained supersonic long range strike core engine.				
(U)	In FY 2009: Complete assembly and demonstration of advanced core engine components, 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 fabrication and initiate performance demonstration of a tip turbine concept, including a novel compression system, innovative annular combustor, and advanced rotating seals. Complete fabrication, assembly and experimental demonstration of unique compression system components. Complete preliminary design of high temperature capable, durable compressor, combustor, and turbine for sustained supersonic long range strike core engine.				
(U)					
(U)	MAJOR THRUST: Design, fabricate, and demonstrate high overall pressure ration cores to provide increased durability and affordability with lower fuel consumption for turbofan/turboshaft engines for long endurance high altitude unmanned air vehicles for persistent intelligence surveillance	1.972	3.547	12.085	12.505

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

reconnaissance, intertheater/intratheater transports, subsonic Unmanned Air Systems (UAS), and powered munitions. Note: The funding in this effort has been increased in FY 2008 and out due to emphasis on component development in support of highly efficient embedded turbine engines and small heavy fueled engines.

(U) In FY 2006: Completed preliminary design of core for highly efficient core engine concept with advanced core technologies including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling effectiveness turbine with an integrated thermal management system and advanced mechanical systems. Completed design and initiated experimental performance demonstration of multi-service heavy fuel engine technologies for future rotorcraft.

(U) In FY 2007: Complete detailed design and initiate fabrication of core components for highly efficient core engine concept with advanced core technologies including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling effectiveness turbine with an integrated thermal management system and advanced mechanical systems. Complete experimental demonstration of the multi-Service heavy fuel engine technologies for future rotorcraft.

(U) In FY 2008: Complete fabrication and initiate assembly of highly efficient core engine components concept with advanced core technologies including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling effectiveness turbine with an integrated thermal management system and advanced mechanical systems. Create preliminary design of UAS small versatile affordable advanced core engine technologies including an efficient high pressure compressor, a high heat release combustor, high performance turbine, and systems for thermal management and advanced power extraction.

(U) In FY 2009: Complete assembly and demonstrate a highly efficient core engine concept with advanced core technologies including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling effectiveness turbine with an integrated thermal management system and advanced mechanical systems. Initiate design of higher pressure ratio core components. Conduct preliminary design of core for highly efficient core engine concept with advanced core technologies including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling effectiveness turbine with an integrated thermal management system and advanced mechanical systems.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	Complete design, initiate hardware fabrication, and continue selective risk reduction experimental demonstrations of UAS small versatile affordable advanced core engine technologies including a high heat release combustor, durable high performance turbine, and systems for thermal management and advanced power extraction.				
(U)					
(U)	CONGRESSIONAL ADD: Versatile Affordable Advanced Turbine Engines (Note: only for project 681B).	0.000	2.192	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Identify and evaluate engine control issues and effects of rapidly drawing large amounts of power off the engine. Assess the viability of a new combustor configuration, an advanced turbine cooling concept, and an advanced high pressure compressor rotor.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	23.427	27.922	33.507	54.536

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) D. Acquisition Strategy

Not Applicable.

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Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE
0603231F Crew Systems and Personnel Protection Technology

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	33.570	43.890	28.558	29.376	37.443	34.885	34.881	37.992	Continuing	TBD
2830	Decision Effectiveness Technology	22.425	30.684	19.513	20.189	27.420	25.381	24.920	27.971	Continuing	TBD
4924	Warfighter Readiness Technology	7.688	9.274	6.249	6.682	6.602	6.043	6.429	6.412	Continuing	TBD
5020	Bioeffects & Protection Technology	3.457	3.932	2.796	2.505	3.421	3.461	3.532	3.609	Continuing	TBD

Note: Funds for the FY 2007 Congressionally-directed Deployment Environmental and Biological Surveillance System (DEBS) in the amount of $1.0 million and Virtual Medical Trainer in the amount of $2.2 million are in the process of being moved to the Defense Health Program from PE 0603231F, Crew Systems and Personnel Protection Technology, 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 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, enhance capabilities for sustained operations in extreme environments, and deliver novel, tailored bio-taggant and identification/neutralization capabilities to meet specific AF special operations needs. Note: In FY 2007, Congress added $2.2 million for Virtual Medical Trainer, $1.0 million for Deployment Environmental and Biological Surveillance System (DEBS), $1.3 million for Authentic Tactical Flight Simulator for JSF, $1.0 million for Full spectrum Laser Eye Protection, $1.0 million for Variable Transmittance Visor, $1.0 million for Field Deployable Influenza Genotyping System, $1.0 million for Database Integration Tools, $1.1 million for Low Cost Improved Performance Helmet Display, $1.0 million for Air Force Advanced Micro-Compression Sock Program, and $1.3 million for Phasor-Bird Helmet Tracker. 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 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	34.968	32.156	32.685	35.835
(U)	Current PBR/President's Budget	33.570	43.890	28.558	29.376
(U)	Total Adjustments	-1.398			
(U)	Congressional Program Reductions				
	Congressional Rescissions	-0.040	-0.166		
	Congressional Increases		10.600		
	Reprogrammings	-0.620	1.300		
	SBIR/STTR Transfer	-0.738			

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603231F Crew Systems and Personnel Protection Technology**	**2830 Decision Effectiveness Technology**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2830	Decision Effectiveness Technology	22.425	30.684	19.513	20.189	27.420	25.381	24.920	27.971	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: Funds for the FY 2007 Congressionally-directed Deployment Environmental and Biological Surveillance System (DEBS) in the amount of $1.0 million and Virtual Medical Trainer in the amount of $2.2 million are in the process of being moved to the Defense Health Program from PE 0603231F, Crew Systems and Personnel Protection Technology, 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 aerospace and cyber operations, support development of novel, tailored bio-taggant and identification/neutralization capabilities and develop aircrew system technologies to support long duration missions. The ultimate goal is to assure warfighter decision effectiveness in AF operations.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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 ever-increasing data load and improve mission accomplishment.	2.834	2.882	1.693	2.580

(U) In FY 2006: Developed and demonstrated tools, methods, and technologies to gain, exploit, defend, and attack information. Developed IO capabilities for enhancement by exemplar technologies and methods. Began 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) In FY 2008: Develop and demonstrate the utility and effectiveness of ISR operator planning tools.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Continue development and demonstration of operator-aiding technologies to exploit data from new ISR sensors and reduce data overload. Expand IO/ISR training research and evaluate new regimens to address training for new ISR missions. Develop Influence Operations technologies and facilitate transition into follow-on IO/ISR operator workload optimization development.				
(U)	In FY 2009: Research advanced IO/ISR technologies to design next-generation IO/ISR operator workstation capabilities to operationally integrate/normalize AF non-kinetic capabilities with kinetic operations. Continue development of operator-aiding and training tools for IO/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).	2.433	3.787	1.950	1.914
(U)	In FY 2006: Developed initial decision-centric visualization tools focused on the areas of strategy planning, assessment of operational effectiveness, and battle predictions. Integrated 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, including spatial audio and voice-over-Internet-protocol communication, to allow more advanced collaboration within the strategy division and with other groups in the CAOC.				
(U)	In FY 2008: Develop a predictive analysis tool based on continuous and dynamic operational effects assessment. Based on operator field test results, develop enhancements that foster command level interaction with the visualization tool for rapid and actionable decision-making.				
(U)	In FY 2009: Integrated visualization tools with other collaborative tools to create a seamless flow of operational assessment data into strategy planning data. Demonstrate a final visually-oriented, unified strategy planning and assessment support tool in a simulated CAOC.				
(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 combat zones. Develop technologies permitting supervisory-level interfaces between ground controllers and multiple, highly autonomous UAVs. Employ real-time wargaming simulations and field tests to quantify the decision-making benefits from advanced control/display portrayal concepts that	2.619	4.083	3.675	3.981

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

optimize net-centric information flow to system operators.

(U) In FY 2006: Developed intelligent unmanned air vehicle (UAV) search patterns for improved target location. Began to develop UAV display tools that speed the delivery of UAV imagery integrated with cultural and targeting information to special operations forces. Continued 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) In FY 2008: Commence a spiral development to extend the capabilities of the advanced interface technologies that link ground controllers with multiple machine components through unified visual and auditory displays. Demonstrate in an operational setting improved human interaction with transmission of target data, in order to improve speed and accuracy while offering a common situation display for Joint services interoperability. Provide human factors design updates to battlefield air operations kit components, providing faster setup and deployment of micro-UAV as well as integrated power management for wearable components. Demonstrate user-independent speech recognition and language translation customized for ground controller equipment and TAC earplug microphones. Begin hardware and software implementation of a supervisory control station technology baseline. Begin concept development for a next-generation supervisory control station, and plan to assess projected benefits in terms of operator mission performance and overall usability relative to the technology baseline station.

(U) In FY 2009: Continue to develop and demonstrate human systems integration concepts for ground controllers and other battlefield airmen. Demonstrate technologies for three-dimensional audio navigation in visually obscured environments while improving team situational awareness by geo-location of voice communications. Incorporate a geo-located survival guide into a wearable computer, and demonstrate its value in an operationally relevant environment. Develop and incorporate an advanced battlefield air traffic control capability in the combat controller's software suite. Incorporate intelligent agent technology to improve battlefield airmen situational awareness in a dynamic wartime scenario. Complete hardware and software implementation of a supervisory control

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	station technology baseline and a next-generation supervisory control station. Plan a technology demonstration program using real-time system simulation and field testing in spiral demonstration phases. Establish the scope of simulation and test activities, select experimental variables, determine key performance measures and commence the assessment.				
(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.	0.412	1.006	1.855	2.263
(U)	In FY 2006: Developed a scenario-based cognitive work analysis based on global strike and global persistent attack missions as a command and control knowledge base for the Commander's Predictive Environment (CPE). Developed 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. Enable real-time reachback to operational and intelligence knowledge sources.				
(U)	In FY 2008: Complete the first spiral development of CPE decision aids and simulation based on global strike and global persistent attack missions. Plan a technology demonstration program to evaluate benefits and utility of tools. Expand the scope of the scenario-based cognitive work to include non-traditional warfare such as humanitarian relief and global war on terrorism. Begin a cognitive work analysis with this expanded scope.				
(U)	In FY 2009: Integrate tools developed in first spiral into identified technology demonstration program. Evaluate the CPE decision aids and simulation tools in the technology demonstration environment. Refine tools and begin the second spiral development cycle informed by the results of the technology demonstration with humanitarian relief and global war on terrorism emphases. Identify exercise to evaluate the expanded benefits and utility of the decision aid tools and simulation. Plan a technology demonstration program.				
(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 2007, this effort is discontinued to align work with higher AF priorities.	2.024	0.251	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2006: Developed lightweight, ruggedized displays that operate in demanding special operations environments. Performed a laboratory evaluation to determine the optimal configuration to present information to special operations personnel. Investigated the utility of incorporating day and night sensors into a single helmet-mounted display.				
(U)	In FY 2007: Complete technology contribution to incorporate night agile laser protection in airborne displays.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate novel, tailored bio-taggant and identification/neutralization capabilities to meet specific AF needs to enhance force protection and enable air operations commanders to maintain operations tempo.	0.391	1.180	1.503	1.522
(U)	In FY 2006: Defined parameters of biological warfare agent identification. Designed new agent identification technologies and appropriate testing methods and conditions to perform operational field evaluations.				
(U)	In FY 2007: Evaluate the capabilities of emerging aptamer technologies to enhance bio-taggant capabilities. Begin development of these DNA-based identification and neutralization technologies that will lead to affordable and reliable techniques for special forces to locate, identify, track, and counter enemy activities.				
(U)	In FY 2008: Select the best emerging technologies for bio-taggant and threat neutralization applications and begin to develop those technologies into fieldable counterproliferation capabilities. Aptamer based technology will also be used to enhance the effectiveness of the cold plasma and directed energy technologies. Develop the capability to attach quantum dots and mixed-metal nanoparticles to aptamers to serve as taggants for biological agents.				
(U)	In FY 2009: Further develop the selected technologies and refine application to mission need to include incorporation of quantum dot and mixed-metal nanoparticle technologies. Develop models of optimal insertion/distribution of bio-taggants in target areas.				
(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	3.879	3.671	4.519	1.180

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	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.				
(U)	In FY 2006: Evaluated methods to improve validating human performance models. Began to develop a human performance model that can represent behavioral variations due to cultural differences. Began to transition a set of work-centered collaborative planning and decision-making software tools to Air Mobility Command. Began to develop composable human-computer interface elements that can be assembled via computer network into a rapidly reconfigurable command and control (C2) system.				
(U)	In FY 2007: Begin a series of critical experiments toward modeling a society as a complex system 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)	In FY 2008: Continue to develop and experiment with system-of-systems societal modeling, increasing the complexity and degree of dynamic change. Expand development of work-centered collaborative planning, analysis, and decision-making software tools into the unstructured C2 work environment of dynamic mission re-synchronization. Investigate the value of implementing human-computer interfaces as services or as service layers of an enterprise architecture.				
(U)	In FY 2009: Continue to develop human behavior modeling of individuals and groups in highly dynamic situations. Continue to experiment with system-of-systems societal modeling, using increasingly complex scenarios. Demonstrate how information flows through and is modified by a society. Develop design reference scenarios to be used as standards for evaluating different modeling approaches. Continue to evaluate promising models and modeling approaches.				
(U)					
(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 AF deployments and mobility operations in support of Agile Combat Support initiatives and Air Expeditionary Force concepts.	4.051	2.039	1.229	2.702
(U)	In FY 2006: Developed and applied technology to automatically collect and update critical information required to effectively manage logistics resources in support of combat operations. Continued to design and develop very fast, easy-to-use dynamic planning/replanning capabilities for adaptive logistics.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	Continued work to define coalition C2 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 C2 information requirements to support cross-cultural planning and coordination. Begin work on defining requirements for emergency response logistics needs.				
(U)	In FY 2008: Evaluate methods for organizational impact analysis of new information and network-based tools to support collaborative logistics. Collect human-centric performance data from critical experiments and joint exercises to benchmark improvements in maintenance, transportation, and supply functions in contingency support.				
(U)	In FY 2009: Develop organizational-level change templates for effective applications of net-based logistics operations. Validate these change templates in operational settings (e.g., airlift control centers, logistics readiness centers) for effective implementation of advanced automation technologies.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate cognitive-based analytic and design methods and computer software tools for C2 operations to synchronize personnel in distributed locations with a shared understanding of the C2 battlespace. Increasingly, C2 personnel operate in a complex information environment that inhibits situation understanding and complicates operational decision-making. This decision support technology exploits an emerging work-centered user interface concept having the potential to rapidly configure common visualizations of C2 operations and streamline decision-making.	0.132	2.535	1.435	1.958
(U)	In FY 2006: Defined the concept of a collaborative toolkit for battle management C2. Established and documented requirements for an advanced C2 workstation that integrates the battle management visualization and collaborative tools.				
(U)	In FY 2007: Begin to analyze the work aiding requirements for specific distributed C2 users such as for rapid course of action development teams supporting global operations. Begin to apply the work-centered user interface concept to develop shared visualizations and decision support for synchronizing global operations involving distributed C2 resources such as for the dynamic management of air refueling operations.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Continue to analyze the work aiding requirements for specific distributed C2 users such as for rapid course of action development teams supporting global operations, to include coverage both for planning and execution. Conduct experiments to test and evaluate the ability of the work-centered user interface services approach to provide effective visualizations and decision support for global C2 operations.				
(U)	In FY 2009: Refine the methods and techniques to decrease the analysis, design and development time of providing work-centered support services for global C2 operations. Demonstrate in a simulation of global C2 operations that geographically distributed personnel can develop a shared situation understanding of the C2 battlespace.				
(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 2008, this effort is discontinued to align work with higher AF priorities.	0.272	0.682	0.756	0.000
(U)	In FY 2006: Developed aircrew safety technologies to support long duration missions. Initiated 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)	In FY 2008: Validate system specification through testing of candidate seat system designs. Continue research and development of seat system technologies to improve performance, safety, and comfort. Demonstrate performance of candidate seat system optimization technologies.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate technologies for improved force protection and maintenance of peak warfighter performance in known toxic environments or uncharacterized environments during deployment. Develop capabilities for real-time human monitoring in the field and the identification of toxic substance exposure before the warfighters' health and combat effectiveness are compromised. Note: This major thrust is a continuation of previous work in PE 0602202F.	0.000	0.000	0.898	2.089
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Begin development of detection technologies to identify kidney and liver organ selective degradation using streamlined, yet robust, assay procedures and biomarkers. Generate selection criteria and integration algorithms that fuse varied biomarker data. Multiple specific biomarkers will allow for early detection of low level toxic exposure of deployed forces.				
(U)	In FY 2009: Continue development of biomarker based detection technologies. Develop methods for collecting human biosample input in the field. Develop new concepts for lightweight monitoring devices that are operable by non-medical personnel for demonstration of the analysis and detection techniques. These technologies will identify potentially threatening toxic exposures to warfighters to protect AF personnel.				
(U)					
(U)	CONGRESSIONAL ADD: Air Force Advanced Micro-Compression Sock (AFAMS).	1.446	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for AFAMS.				
(U)	In FY 2007: Conduct Congressionally-directed effort for AFAMS.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Variable Transmittance Visor.	0.966	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Variable Transmittance Visor.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Variable Transmittance Visor.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Phasor-Bird Helmet Tracker (previously titled Next Generation Helmet Tracking and Display Technology).	0.966	1.296	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Next Generation Helmet Tracking and Display Technology.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Phasor-Bird Helmet Tracker.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Field Deployable Influenza Genotyping System.	0.000	0.996	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Field Deployable Influenza Genotyping System.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Low Cost Improved Performance Helmet Display.	0.000	1.096	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Low Cost Improved Performance Helmet Display.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Virtual Medical Trainer.	0.000	2.192	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Virtual Medical Trainer.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Deployment Environmental and Biological Surveillance (DEBS).	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for DEBS.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	Total Cost	22.425	30.684	19.513	20.189

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0602202F, Human										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) C. Other Program Funding Summary ($ in Millions)

Effectiveness Applied Research.

(U) PE 0604706F, Life Support Systems.

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603231F Crew Systems and Personnel Protection Technology**	**4924 Warfighter Readiness Technology**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4924 Warfighter Readiness Technology	7.688	9.274	6.249	6.682	6.602	6.043	6.429	6.412	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(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 2006	FY 2007	FY 2008	FY 2009
(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.	2.139	3.007	3.108	3.100
(U) In FY 2006: Demonstrated the performance evaluation and tracking system. Integrated the current battlefield air operations toolkit training devices into an immersive, Distributed Mission Operations (DMO) compatible training system, capable of mission training and rehearsal. Developed 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 interface parameters to link DMO mission training centers and live training ranges. Develop a proof of concept joint close air support schoolhouse simulation environment. Develop preliminary exercise planning and analysis shells to enable a robust scenario authoring capability that reduces training development time. Develop performance measurement/monitoring technologies and methods for a deployable training environment. Perform a small-footprint training demonstration in a persistent wargaming environment. Initiate development of functional requirements for managing learning in distributed training contexts.				
(U) In FY 2008: Develop integrated methods for assessing and tracking performance in live, virtual, and constructive environments. Develop and demonstrate integrated readiness assessment for air-to-air, air-to-ground, close air support, and C2. Demonstrate interface and training capability between DMO				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	and live range exercises. Continue development of scenario authoring shells amenable for guiding training and learning in virtual and live contexts. Develop integrated methods for evaluating the impact of different levels of fidelity in simulation environments on performance and readiness. Finalize the development of functional requirements for managing learning in distributed training contexts.				
(U)	In FY 2009: Demonstrate adaptive training within DMO using embedded knowledge and skills assessment. Develop common tools for mission planning, briefing, and after action review that function across air combat, ground operations, and combat operations and planning in an AOC. Complete integration and evaluation of joint close air support environment for schoolhouse training. Evaluate technology alternatives for in-garrison and field deployable joint close air support training. Initiate development of specifications for integrating forward deployed battlefield coordination and command simulation with joint close air support schoolhouse training. Demonstrate embedded training and performance assessment in a deployed combat training environment.				
(U)					
(U)	MAJOR THRUST: Develop a low-cost, deployable visual simulation system with sufficient image resolution and performance capable of supporting the imaging of high-resolution fast-moving targets, high-density terrain, texture, surround imagery, and helmet-mounted sights. This technology will provide the warfighter realistic air-to-air and air-to-ground visual simulation environments to support aircrew training during expeditionary deployments and at mission training centers.	0.793	1.154	1.284	1.150
(U)	In FY 2006: Designed and developed off-boresight targeting simulation for DMO multifaceted simulator displays. Defined display design requirements for head-mounted and deployable training devices, defined next generation design configurations, and evaluated alternative display concepts.				
(U)	In FY 2007: Begin development of advanced, ultra resolution head-mounted and deployable Compact Immersive Visual Environment (CIVE) proof-of-concept display components. Begin engineering and human factors analyses of the display components.				
(U)	In FY 2008: Continue engineering and human factors analyses of the CIVE display and image generation components to assess feasibility of new scanning architectures, image fidelity and stability, portability, resolution, size, weight, transport delay, and user acceptance.				
(U)	In FY2009: Develop a CIVE technology demonstrator. Begin evaluation and validation of the technology demonstrator.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate training technologies and techniques to optimize night	1.619	0.724	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	vision device-aided night operations. These technologies could reduce the cost of Night Vision Goggle (NVG) qualification and increase combat capability. Note: In FY 2008, this effort terminates due to higher AF priorities.				
(U)	In FY 2006: Developed desktop NVG visualization trainer for mission preview and mishap investigation applications. Developed NVG mission brief/debrief technologies. Developed NVG spatial orientation training protocols. Developed and evaluated performance metrics for NVG instrument scan, cross-check, and spatial orientation. Developed formats for reusable and interoperable material properties-coded datasets suitable for NVG and other sensor simulation. Developed and evaluated physics-based simulation approach in a variety of visual displays. Developed 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 desktop NVG visualization training. Test simulated panoramic NVG in DMO testbed. 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(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. Develop and demonstrate high-fidelity, interactive Electronic Warfare (EW) training technologies for use with live-virtual-constructive training networks for future threat systems/capabilities and advanced sensor platforms and weapons systems. These technologies provide AF, Joint, and coalition warfighters with more realistic EW mission training and rehearsal environments that accurately represent 21st century threats, thereby increasing operational readiness and capability.	1.497	2.098	1.857	2.432
(U)	In FY 2006: Developed performance indicators to enable performance measurement capability for team- and individual-level AOC operators. Developed initial functional specifications for computer-assisted training scenario for AOC operators. Enhanced training syllabi and methods for team- and individual-level AOC operators based on current scientific and cognitive science principles.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	Developed AOC training and rehearsal capabilities within the larger DMO training and rehearsal environment.				
(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)	In FY 2008: Develop competency-based training requirements for team and functional areas within strategy and plans divisions including IO and ISR teams. Develop optimum training and mission rehearsal strategies to employ information simulation into AOC weapon systems planning tools. Survey instructional methods for employment in targeted training of mission-essential knowledge and skills and develop most capable method(s) for integration. Begin the design and development of architectures and hardware that integrate live EW range data into shared networked simulations. Begin the development of a simulation of an advanced fighter-specific EW sensor suite for DMO application. Demonstrate guiding a single EW training illuminator on a live electronic combat range with fully integrated, computer-generated, and live forces.				
(U)	In FY 2009: Develop integration methods for fielded and emerging systems and applications. Develop team, inter-team and division-level event specifications for mission qualification training and continuation training scenarios. Validate environment approaches through exercise simulations, data capture, and analysis to define quality of experience, spectrum of training capability, and performance assessment capabilities. Complete live EW range integration into DMO. Develop a simulation of an advanced platform-specific EW sensor suite for DMO. Develop a proof-of-concept desktop system integrating multiple EW suite simulations with a synthetic threat environment featuring advanced missile fly out models and basic directed energy threats. Begin measuring and validating improvements in EW training using these technologies and techniques. Begin the development of methods for improved, embedded EW training capability on airborne aircraft and design systems and demonstrate these technologies during a live-fly exercise at an EW training range.				
(U)					
(U)	CONGRESSIONAL ADD: Air Operations Center Secured Data Access.	1.640	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Air Operations Center Secured Data Access.				
(U)	In FY 2007: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Authentic Tactical Flight Simulator for JSF.	0.000	1.295	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Authentic Tactical Flight Simulator for JSF.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Database Integration Tools.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2006: Conduct Congressionally-directed effort for Database Integration Tools.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	Total Cost	7.688	9.274	6.249	6.682

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) **D. Acquisition Strategy**

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603231F Crew Systems and Personnel Protection Technology**	**5020 Bioeffects & Protection Technology**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5020	Bioeffects & Protection Technology	3.457	3.932	2.796	2.505	3.421	3.461	3.532	3.609	Continuing	TBD
	Quantity of RDT&E Articles	0	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 man-portable technologies for the neutralization of threats. 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. Biobehavioral performance capabilities are developed and demonstrated to enable sustained and enhanced operations in extreme environments to include surge, night, global, information warfare, C2, and other operations.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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. Note: This effort completes in FY 2007.	0.740	0.600	0.000	0.000
(U) In FY 2006: Completed airworthiness testing on LEP for Airborne Laser (ABL) flight test team. Continued development of an integrated LEP demonstration system to provide full-spectrum laser protection while restoring vision degraded by the LEP to better than normal. Initiated development of wrap-around LEP spectacle technology with prescription capabilities.				
(U) In FY 2007: Complete development of integrated eye protection technologies. Demonstrate and deliver second-generation LEP goggles for Special Operations air and ground forces, assessing human factors and mission compatibility.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) MAJOR THRUST: Develop and demonstrate technologies that permit safe testing, deployment, and use of high energy laser weapons and systems.	0.374	0.820	0.908	0.757
(U) In FY 2006: Integrated 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	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)	In FY 2008: Release laser range safety software tool including dynamic bi-directional reflectivity distribution function to support live fire test of major systems. Initiate validation, verification, and accreditation package for new software package Continue assessment of probabilistic risk assessment for use with laser hazard assessment.				
(U)	In FY 2009: Complete validation, verification, and accreditation package for laser range safety tool. Release collateral hazard assessment software tool to enable analysis of tactical uses for high-energy laser systems.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate technologies to assess bioeffects and protection from radio frequency (RF) systems, including terahertz technologies. Note: This major thrust is a continuation of previous work in PE 0602202F.	0.000	0.000	0.888	1.581
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Initiate program to develop solutions for both laser and other non-iodizing radiation to personnel. Integrate laser solutions into solutions for RF, microwave, terahertz, and other regimes of electromagnetic radiation for personnel protection.				
(U)	In FY 2009: Continue to develop laser and RF and other non-ionizing protective solutions for personnel protection. Continue integration of laser protective technologies with those for RF, microwave, terahertz, and other regimes of electromagnetic radiation for personnel protection. Establish preliminary design specifications for directed energy protective equipment. Continue long-term studies of RF weapon systems effects.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate technologies to support testing of counterforce technologies and to enable man-portable threat neutralization capabilities.	0.437	0.864	0.639	0.167
(U)	In FY 2006: Enhanced neutralization technologies to optimize performance for specific operational conditions. Conducted laboratory tests to assess performance under simulated operational conditions.				
(U)	In FY 2007: Refine and downselect neutralization devices, develop simulant testing capabilities, and integrate with threat detection technologies. Demonstrate most promising man-portable threat neutralization technologies in simulated environments.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Begin developing technologies that will provide the capability to neutralize threats without leaving evidence for special applications. Develop technologies to enable safe return and avoid contaminating aircraft or other equipment.				
(U)	In FY 2009: Continue development of technologies that will provide the capability to neutralize threats without evidence for special applications. Improve technologies to enable safe return and avoid contaminating aircraft or other equipment.				
(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: This effort completes in FY 2008.	0.940	0.652	0.361	0.000
(U)	In FY 2006: Integrated modeling of specific fatigue effects and interventions into model-based fatigue management capability. Improved and demonstrated operational usability of fatigue management capability. Expanded fatigue model capability to predict operational task performance and address shiftwork applications.				
(U)	In FY 2007: Integrate biobehavioral performance model for selected military tasks, such as airlift/tanker crew scheduling and special forces mission planning.				
(U)	In FY 2008: Complete development and demonstrate quantitative biobehavioral performance management tools to provide scheduling solutions and operational risk management calculations to extend and enhance human performance in sustained and continuous (24/7) military operations.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Full Spectrum Laser Eye Protection.	0.966	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Full Spectrum Laser Eye Protection.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Full Spectrum Laser Eye Protection.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	Total Cost	3.457	3.932	2.796	2.505

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) C. Other Program Funding Summary ($ in Millions)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

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Exhibit R-2, RDT&E Budget Item Justification

DATE: **February 2007**

BUDGET ACTIVITY
03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE
0603270F Electronic Combat Technology

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	32.247	28.528	23.743	21.287	23.832	25.862	26.376	26.939	Continuing	TBD
2432	Defensive System Fusion Technology	7.367	5.163	5.398	5.943	6.931	7.862	8.908	7.293	Continuing	TBD
431G	RF Warning & Countermeasures Tech	9.264	9.352	7.743	6.862	8.460	7.774	7.043	9.007	Continuing	TBD
691X	EO/IR Warning & Countermeasures Tech	15.616	14.013	10.602	8.482	8.441	10.226	10.425	10.639	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 2007 Congress added $1.0 million for RAPCEval; $1.9 million for Affordable Visible Missile Warning System; and $1.3 million for BLADES. 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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	33.342	24.436	24.857	26.978
(U)	Current PBR/President's Budget	32.247	28.528	23.743	21.287
(U)	Total Adjustments	-1.095			
(U)	Congressional Program Reductions				
	Congressional Rescissions	-0.002	-0.108		
	Congressional Increases		5.200		
	Reprogrammings	-0.353	-1.000		
	SBIR/STTR Transfer	-0.740			

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603270F Electronic Combat Technology**

Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2432	Defensive System Fusion Technology	7.367	5.163	5.398	5.943	6.931	7.862	8.908	7.293	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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 FY 2006.	0.850	0.000	0.000	0.000
(U) In FY 2006: Completed the electronic attack (EA)/electronic support (ES) system integration. Conducted 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. Developed an integrated, networked approach to disrupt and deny current and future integrated air defense systems.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) MAJOR THRUST: Develop and integrate advanced sensor receiver and processing technologies. Note: This effort completes in FY 2007.	0.574	0.698	0.000	0.000
(U) In FY 2006: Performed risk reduction for defensive sensors using 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 network EA techniques on disparate platforms. Conducted 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.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603270F Electronic Combat Technology**	PROJECT NUMBER AND TITLE **2432 Defensive System Fusion Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2007: Complete risk reduction for defensive sensors using multiple information sources for situational awareness in the IDAL. Complete 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop affordable radio frequency (RF) and electro-optical (EO) emitter warning concepts and techniques. Develop techniques for coordination and management of multiple jamming nodes against integrated air defense systems (IADS). Conduct integrated electronic warfare (EW)/ information operations (IO) simulations and demonstrations for integrated air defense systems (IADS) deception and defeat.	4.016	4.465	5.398	5.943
(U)	In FY 2006: Designed and initiated demonstration of advanced threat alert and jamming subsystem for combat aircraft to increase survivability against advanced, integrated RF, EO, and infrared (IR) air defense systems. Performed 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)	In FY 2008: Complete maturation demonstration of advanced threat alert and jamming subsystem for combat aircraft to increase survivability against advanced, integrated RF, EO, and IR air defense systems. Investigate electronic warfare (EW) battle management strategies and technical protocols for control of multiple jamming nodes working in coordination against an IADS in the overall context of non-traditional intelligence, surveillance, and reconnaissance and strike operations. Develop and demonstrate technical protocols for the integration of EW, C2W, and IO operations against an IADS.				
(U)	In FY 2009: Conduct analyses and initial demonstrations of EW battle management strategies in the IDAL and VCL simulation facilities. Continue to develop and demonstrate technical protocols for the integration of EW, C2W, and IO operations against an IADS.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)					
(U)					
(U)	CONGRESSIONAL ADD: Advanced Threat Alert ATD (Advanced Technology Demonstration) - Technology Insertion.	1.927	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Advanced Threat Alert ATD - Technology Insertion.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	7.367	5.163	5.398	5.943

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603270F Electronic Combat Technology**	**431G RF Warning & Countermeasures Tech**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
431G	RF Warning & Countermeasures Tech	9.264	9.352	7.743	6.862	8.460	7.774	7.043	9.007	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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). Note: This effort completes in FY 2008.	1.565	1.557	1.165	0.000
(U) In FY 2006: Designed and fabricated 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) In FY 2008: Complete integration and test of an array compatible with UAV platforms.				
(U) In FY 2009: Not Applicable.				
(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. Develop coordinated, multi-player radar jamming techniques for deception and neutralization of early warning and surveillance networks to enable all-platform operations in defended adversary airspace. Develop new electronic attack (EA) techniques fusing advanced digital signal processing receivers with digital technique generators.	5.771	6.799	6.578	6.862
(U) In FY 2006: Developed self-protection countermeasures effective against fourth generation surface-to-air missile systems. Developed and conducted laboratory evaluations of advanced countermeasures techniques and technology to defeat an advanced integrated air defense system (IADS). Laboratory- and field-tested innovative, networked RF countermeasure techniques against advanced				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603270F Electronic Combat Technology**	PROJECT NUMBER AND TITLE **431G RF Warning & Countermeasures Tech**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	target engagement radars. Developed anti-jam techniques and technologies for advanced RF sensor systems. Demonstrated a lightweight, low-profile, multi-function, active electronically scanned array on an airborne test bed. Analyzed data from flight test and predicted system performance using advanced computational techniques.				
(U)	In FY 2007: Continue developing self-protection countermeasures effective against advanced future surface-to-air missile systems. Complete laboratory and field-testing of innovative, networked RF countermeasure techniques against advanced target engagement radars. Complete development of advanced countermeasures techniques and technology to defeat an advanced IADS. Continue developing anti-jam techniques and technologies for advanced RF sensor systems. Complete demonstration of 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)	In FY 2008: Provide hardware simulation and analysis support to multi-intelligence sensor needs for accurate and timely electronic surveillance information. Conduct threat research, simulation, and analysis of early warning radar characteristics. Develop multiple technical strategies and techniques for deceiving early warning radars in a network enabled operational environment. Develop advanced simulation capabilities to support network enabled jamming of adversary early warning and surveillance networks. Develop and evaluate integrated digital receiver/jammer architectures.				
(U)	In FY 2009: Continue to provide hardware simulation and analysis support to multi-intelligence sensor needs for accurate and timely electronic surveillance information. Develop advanced radar jamming engineering models including technique generators, wide band amplifier modules and apertures, needed to conduct network enabled research and evaluation of countermeasure techniques. Continue to develop advanced simulation capabilities to support network enabled jamming of adversary early warning and surveillance networks. Continue to develop and evaluate integrated digital receiver/jammer architectures.				
(U)					
(U)	CONGRESSIONAL ADD: Electronic Combat Battle Management.	0.964	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Electronic Combat Battle Management.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603270F Electronic Combat Technology**	PROJECT NUMBER AND TITLE **431G RF Warning & Countermeasures Tech**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)					
(U)	CONGRESSIONAL ADD: Receiver and Processing Concepts Evaluation (RAPCEval).	0.964	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for RAPCEval.				
(U)	In FY 2007: Conduct Congressionally-directed effort for RAPCEval.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	9.264	9.352	7.743	6.862

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603270F Electronic Combat Technology**	**691X EO/IR Warning & Countermeasures Tech**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
691X	EO/IR Warning & Countermeasures Tech	15.616	14.013	10.602	8.482	8.441	10.226	10.425	10.639	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Analyze the vulnerabilities of current IR missile systems and future imaging IR sensors. Note: Increased funding in FY 2006 supported field demonstration of cooperative techniques and expendable decoys with modified spatial and kinematic properties for countering IR missiles.	4.197	2.104	1.905	1.539
(U)	In FY 2006: Conducted in-house analyses on IR-guided missile and future imaging IR sensor susceptibilities. Evaluated 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)	In FY 2008: Conclude 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. Identify optimal countermeasure techniques to defeat single color imaging IR sensors.				
(U)	In FY 2009: Perform laboratory analyses on future IR guided missile capabilities. Assess effectiveness of current and planned techniques against new threat trends and direction of future countermeasure technique requirements. Conduct digital simulations to assess effectiveness of expendable and laser countermeasure techniques.				
(U)					
(U)	MAJOR THRUST: Develop aerospace laser warning sensor technologies for timely alert to advanced	1.953	1.840	1.536	1.709

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser-guided ordnance) signals.				
(U)	In FY 2006: Developed advanced laser warning receivers for aircraft. Developed laser warning sensor technologies to address emerging laser threats. Developed 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)	In FY 2008: Continue developing laser warning sensors to address emerging laser threats. Develop miniaturized laser warning sensors. Fabricate compact device for personnel protection. Demonstrate capability to geolocate laser threats for enhanced situational awareness.				
(U)	In FY 2009: Continue developing laser warning sensors to address emerging laser threats. Continue development of miniaturized laser warning sensors. Fabricate sensor for sensor and eye protection cueing. Demonstrate capability to cue agile filters for optimized protection against advanced laser threats.				
(U)					
(U)	MAJOR THRUST: Develop a countermeasure technology to defeat passive EO and IR aircraft tracking sensors and ordnance guidance.	2.897	5.955	5.592	5.234
(U)	In FY 2006: Completed development of testbed to locate and counter passive threats before threats can develop a fire control solution. Conducted field demonstration over extended ranges to demonstrate capability.				
(U)	In FY 2007: Continue field tests to locate and counter passive threats before threats can develop a fire control solution. Initiate development of a tower demonstration system. Demonstrate capability to scan wide field of regard and locate passive surveillance sensors in real time.				
(U)	In FY 2008: Complete field tests to locate and counter passive threats before threats can develop fire control solution. Complete tower demonstration system development and conduct experiments over 2 km range. Evaluate effectiveness of countermeasure techniques against night vision devices and other passive surveillance sensors.				
(U)	In FY 2009: Initiate development of affordable, lightweight infrared countermeasures capability combining passive surveillance and missile defeat techniques for tactical aircraft. Initiate design of a compact system to geolocate and identify threats.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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. Note: This effort completes in FY 2008.	0.882	0.926	1.569	0.000
(U)	In FY 2006: Performed integration of subsystem components into affordable visible missile warning system (AVMWS). Performed test and evaluation of AVMWS. Coordinated AVMWS development with the Affordable Laser Infrared Survivability System countermeasure system.				
(U)	In FY 2007: Complete test and evaluation of AVMWS.				
(U)	In FY 2008: Characterize sensor performance in varied background clutter. Identify maximum detection ranges for high priority threat missiles.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Detect and Avoid for UAVs.	1.349	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Detect and Avoid for UAVs.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Infrared Countermeasures Electronics Improvement Program.	0.965	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for the Infrared Countermeasures Electronics Improvement Program.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Affordable Visible Missile Warning System.	2.024	1.893	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for the Affordable Visible Missile Warning System.				
(U)	In FY 2007: Conduct Congressionally-directed effort for the Affordable Visible Missile Warning System.				
(U)	In FY 2008: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Battlefield Laser Detection System (BLADES).	1.349	1.295	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for BLADES.				
(U)	In FY 2007: Conduct Congressionally-directed effort for BLADES.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	15.616	14.013	10.602	8.482

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										
(U) PE 0604270N, EW Development.										
(U) PE 0603203F, Advanced Aerospace Sensors.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) **D. Acquisition Strategy**

Not Applicable.

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Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE
0603311F Ballistic Missile Technology

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	11.146	9.365	0.000	0.000	0.000	0.000	0.000	0.000	0.000	47.294
4091 Missile Electronics	11.146	9.365	0.000	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 2007, Congress added $1.8 million for Forward Based Conventional Strike, $4.0 million for Minuteman III, $1.2 million for Pacific Ballistic Missile Technology Program, and $2.4 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 2006	FY 2007	FY 2008	FY 2009
(U) Previous President's Budget	11.435	0.000	0.000	0.000
(U) Current PBR/President's Budget	11.146	9.365	0.000	0.000
(U) Total Adjustments	-0.289			
(U) Congressional Program Reductions				
Congressional Rescissions		-0.035		
Congressional Increases		9.400		
Reprogrammings				
SBIR/STTR Transfer	-0.289			

(U) Significant Program Changes:

In FY 1997, the Air Force eliminated this program. However, Congress has added funds for Congressional-directed efforts since FY 1997.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4091 Missile Electronics	11.146	9.365	0.000	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	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 2007, Congress added $1.8 million for Forward Based Conventional Strike, $4.0 million for Minuteman III, $1.2 million for Pacific Ballistic Missile Technology Program, and $2.4 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.

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	CONGRESSIONAL ADD: Ballistic Missile Technology/Minuteman III.	7.975	3.985	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Ballistic Missile Technology.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Minuteman III.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Pacific Ballistic Missile Technology Program.	1.249	1.196	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Pacific Ballistic Missile Technology Program.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Pacific Ballistic Missile Technology Program.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: P-Net.	1.922	2.391	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for P-Net.				
(U)	In FY 2007: Conduct Congressionally-directed effort for P-Net.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Forward Based Conventional Strike.	0.000	1.793	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Forward Based Conventional Strike.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603311F Ballistic Missile Technology**	PROJECT NUMBER AND TITLE **4091 Missile Electronics**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	11.146	9.365	0.000	0.000

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602204F, Aerospace Sensors.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

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Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE
0603400F J-UCAS Joint Program Office

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	80.362	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5067	Unmanned Combat Air Vehicle Tech Demo	80.362	0.000	0.000	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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	76.691	0.000		
(U)	Current PBR/President's Budget	80.364	0.000		
(U)	Total Adjustments	3.673			
(U)	Congressional Program Reductions				
	Congressional Rescissions				
	Congressional Increases				
	Reprogrammings	5.610			
	SBIR/STTR Transfer	-1.937			

(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 2007**

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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5067	Unmanned Combat Air Vehicle Tech Demo	80.362	0.000	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	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 2006	FY 2007	FY 2008	FY 2009
(U)	Continue development of J-UCAS systems, specifically the Boeing and Northrop Grumman demonstrator programs	80.364			
(U)	Total Cost	80.364	0.000	0.000	0.000

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Defense-Wide RDT&E (PE0603400D8Z)	0.000	0.000	0.000	0.000	0.000	0.000				
(U)	Defense-Wide RDT&E (PE0604400D8Z)	0.000	0.000	0.000	0.000	0.000	0.000				
(U)	AF RDT&E (PE0604400F)	224.360	0.000	0.000	0.000	0.000	0.000				TBD
(U)	NAVY RDT&E (PE0604402N)	0.000	239.000	310.000	369.400	491.100	421.000			Continuing	TBD

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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.

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Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2007

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	86.327	101.115	78.704	85.838	99.947	100.531	94.156	95.707	Continuing	TBD
2181	Spacecraft Payloads	30.434	30.389	22.801	27.423	29.265	29.277	23.072	23.611	Continuing	TBD
3834	Integrated Space Technology Demonstrations	27.241	27.461	28.929	32.147	41.825	41.475	38.916	39.376	Continuing	TBD
4400	Space Systems Protection	3.369	3.439	4.958	6.039	6.798	6.867	7.744	7.907	Continuing	TBD
5021	Space Systems Survivability	4.428	4.806	4.866	5.292	5.489	5.571	5.684	5.808	Continuing	TBD
5083	Ballistic Missiles Technology	3.488	3.901	5.847	6.197	6.472	6.625	6.611	6.607	Continuing	TBD
682J	Spacecraft Vehicles	17.367	31.119	11.303	8.740	10.098	10.716	12.129	12.398	Continuing	TBD

Note: Funds for the FY 2007 Congressionally-directed Massively Parallel Optical Interconnects in the amount of $1.1 million were moved from this PE to PE 0603789F, C3I Advanced Development, Project 634216, for execution. Also, funds for the FY 2007 Congressionally-directed Advanced Satellite Thermal Control Program were moved from PE 0603211F, Aerospace Technology Development and Demonstration, Project 63486U, to this PE, for execution.

(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 2007, Congress added $2.9 million for Precision Integrated Navigation and Position-Intelligent Networking Technology; $1.6 million for Space Situational Awareness/Star Tracking System; $1.0 million for Information Sciences Institute Microsatellite Serial Manufacturing Demonstration Program; $1.1 million for Small Low-Cost Reconnaissance Spacecraft; $1.0 million for Photovoltaic Module Development for Lighter Than Air Vehicles; $1.0 million for Radically Segmented Launch Vehicle (RSLV) Risk Reduction; $1.0 million for Micromachined Switches for Next-Generation Modular Satellites; $1.0 million for Large Automated Production of Expendable Launch Structures (LAPELS); $2.0 million for Microsatellite Serial Manufacturing; $2.8 million for Systemic Hierarchical Approach to Radiation Hardened Electronics; $1.0 million for COTS Technology for Situational Awareness; $1.0 million for Integrated Passive Microelectronic Components; $1.3 million for Integrated Spacecraft Engineering Tool; $1.4 million for Intelligent Free Space Optical Satellite Communications Node; $1.1 million for Massively Parallel Optical Interconnects; and $10.4 million for Thin Film Amorphous Solar Arrays. 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 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603401F Advanced Spacecraft Technology**

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

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	85.564	68.026	79.897	85.435
(U)	Current PBR/President's Budget	86.327	101.115	78.704	85.838
(U)	Total Adjustments	0.763			
(U)	Congressional Program Reductions		-0.028		
	Congressional Rescissions	-0.002	-0.383		
	Congressional Increases		33.200		
	Reprogrammings	2.280	0.300		
	SBIR/STTR Transfer	-1.515			

(U) Significant Program Changes:

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 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603401F Advanced Spacecraft Technology**	**2181 Spacecraft Payloads**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2181 Spacecraft Payloads	30.434	30.389	22.801	27.423	29.265	29.277	23.072	23.611	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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.	10.110	11.068	11.662	13.417
(U) In FY 2006: Developed and validated the building blocks for a general-purpose processor at 500 million instructions per second. Provided the set of design tools for integrating hardening by design into commercial design tools. Fabricated a 16 megabyte chalcogenide-based nonvolatile memory. Designed initial hardened structured application specific integrated circuit (ASIC) to implement increased ASIC performance on low cost devices. Designed and fabricated the initial test vehicle to demonstrate the miniaturized military Global Positioning System (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) In FY 2008: Initiate capabilities to the current Satellite Design Automation software to evolve a logical sequence to form a "push-button toolflow" satellite builder. Initiate radiation-harden space sensor				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	interface modules allocating standardized data messages protocols from sensors for ease device control of sensors and actuators.				
(U)	In FY 2009: Complete capabilities to the current Satellite Design Automation software to evolve a logical sequence to form a "push-button toolflow" satellite builder. Demonstrate radiation-harden space sensor interface modules allocating standardized data messages protocols from sensors for ease device control of sensors and actuators.				
(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.	3.219	2.523	2.699	2.775
(U)	In FY 2006: Validated command and control capabilities and guidance, navigation, and control algorithms for proximity operations with flight experiment data. Refined command, control, guidance, and navigational capabilities for space superiority to apply to space situational awareness and offensive/defensive operations. Completed command and telemetry simulation development for mission ops center testing. Completed integration of hardware-in-the-loop engineering development unit into testbed, interface with spacecraft command and telemetry simulations, and conducted mission ops center testing. Built 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 aperture sensor analysis tool for engineering level, mission/engagement and campaign level analyses.				
(U)	In FY 2008: Further refine command, control, guidance, and navigational capabilities for space superiority. Continue to integrate autonomous flight software technologies with command, control, guidance, and navigation technologies. Continue to extend hardware-in-the-loop testbed, spacecraft command and telemetry simulations, and mission ops centers. Begin to model command, control, and communications systems, conduct engineering trades, and perform military utility analysis.				
(U)	In FY 2009: Complete command, control, guidance, and navigational capabilities for space superiority.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Complete integration of autonomous flight software technologies with command, control, guidance, and navigation technologies. Complete extension of hardware-in-the-loop testbed, spacecraft command and telemetry simulations, and mission ops centers. Continue to model command, control, and communications systems, conduct engineering trades, and perform military utility analysis.				
(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.	0.625	1.227	0.718	0.738
(U)	In FY 2006: Expanded development of models of surveillance systems for military utility to include tactical surveillance and electro-optical technologies. Developed model responsive and reconfigurable technologies. Refined 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)	In FY 2008: Begin development of space-based communications models for blue force situational awareness, communications on the move, and data exfiltration. Complete development of models of responsive or reconfigurable technologies. Continue to 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)	In FY 2009: Continue to develop space-based communications models for blue force situational awareness, communications on the move, and data exfiltration. Apply additional 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. Note: In FY 2008, increase in funding is due to	2.557	2.657	6.458	9.397

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	increased emphasis on hardened focal planes for the next generation satellite.				
(U)	In FY 2006: Assessed large format Read Out Integrated Circuits (ROICs), designed through radiation hardened-by-design (RHBD), and fabricated on existing foundries. Investigated the readout and greater focal plane array performance enhancements needed for emerging detector array technologies.				
(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)	In FY 2008: Continue studies for detectors and readouts needed for exquisite imaging. Increase size/speed of RHBD ROICs. Fold radiation hardness improvement of visible sensor with RHBD ROIC into full focal plane array.				
(U)	In FY 2009: Begin full focal plane array for exquisite imaging. Develop visible sensor for potential transition.				
(U)					
(U)	MAJOR THRUST: Develop technologies for multi-access laser communications space terminals with reduced weight, power, and cost for transformational communications.	2.102	1.343	1.064	0.887
(U)	In FY 2006: Developed components toward space-qualification and brassboard integration. Developed multi-access laser communications terminal brassboard. Tested components/system in relevant environment.				
(U)	In FY 2007: Finalize brassboard integration.				
(U)	In FY 2008: Begin multi-access laser communications terminal form-fit-function development. Continue environmental testing of multi-access laser communications terminal components and subsystems in relevant environment.				
(U)	In FY 2009: Complete multi-access laser communications terminal form-fit-function demonstration. Complete testing of multi-access laser communications terminal components and subsystems in relevant environment. Initiate multi-access laser communications terminal system level testing in relevant environment.				
(U)					
(U)	MAJOR THRUST: Develop spectral/polarimetric sensing and data exploitation demonstrations for military imaging and remote sensing applications. Note: In FY 2006, advanced and accelerated efforts from PE 0602601F, Space Technology.	1.847	0.214	0.200	0.209
(U)	In FY 2006: Completed polarimetric focal plane array (FPA) test article and validate performance. Integrated FPA into laboratory camera and collect high quality data in the laboratory of relevant				

Exhibit R-2a, RDT&E Project Justification

DATE	February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603401F Advanced Spacecraft Technology**	**2181 Spacecraft Payloads**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	materials.				
(U)	In FY 2007: Conduct field collection with polarimetric focal plane camera. Demonstrate feasibility of hardware design for transition to acquisition system.				
(U)	In FY 2008: Collect laboratory data of satellites using spectral/polarimetric sensing and demonstrate applicability of techniques for space situational awareness.				
(U)	In FY 2009: Compare measurements of satellites to predictive models and determine the feasibility of model based exploitation for space situational awareness.				
(U)					
(U)	CONGRESSIONAL ADD: Alternating Current (AC) Coupled Interconnect.	1.452	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for AC Coupled Interconnect.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Magnetoresistive Random Access Memory (MRAM) Innovative Communications Materials/Magnetic Random-Access Memory Communications Materials.	0.968	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Magnetic Random-Access Memory Communications Materials.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Radiation Hardened Microelectronics.	1.162	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Radiation Hardened Microelectronics.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Systemic Hierarchical Approach to Radiation Hardened Electronics.	2.324	2.790	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for System Approach to Radiation Hardened Electronics.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603401F Advanced Spacecraft Technology**	PROJECT NUMBER AND TITLE **2181 Spacecraft Payloads**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2007: Conduct Congressionally-directed effort for Systemic Hierarchical Approach to Radiation Hardened Electronics.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADDS: Intelligent Free Space Optical Satellite Communications Node.	2.906	1.395	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Intelligent Free Space Optical Satellite Communications Node.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Intelligent Free Space Optical Satellite Communications Node.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Precision Integrated Navigation and Position-Intelligent Networking Technology.	1.162	2.889	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Precision Integrated Navigation and Position-Intelligent Networking Technology.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Precision Integrated Navigation and Position-Intelligent Networking Technology.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: COTS Technology for Situational Space Awareness.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for COTS Technology for Situational Space Awareness.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Integrated Passive Microelectronic Components.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603401F Advanced Spacecraft Technology**	PROJECT NUMBER AND TITLE **2181 Spacecraft Payloads**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2007: Conduct Congressionally-directed effort for Integrated Passive Microelectronic Components.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Integrated Spacecraft Engineering Tool. Note: This Add has been previously executed in Project 633834.	0.000	1.295	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Integrated Spacecraft Engineering Tool.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Micromachined Switches for Next-Generation Modular Satellites.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Micromachined Switches for Next-Generation Modular Satellites.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	30.434	30.389	22.801	27.423

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

(U) PE 0603311F, Ballistic Missile 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 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603401F Advanced Spacecraft Technology**	**3834 Integrated Space Technology Demonstrations**

Cost ($ in Millions)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3834	Integrated Space Technology Demonstrations	27.241	27.461	28.929	32.147	41.825	41.475	38.916	39.376	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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.	23.948	26.465	28.929	32.147
(U) In FY 2006: Completed autonomous flight demonstration. Completed next in series of satellite designs. Procured initial bus and payload hardware. Fabricated payload and bus.				
(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) In FY 2008: 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) In FY 2009: Complete autonomous flight demonstration. Perform de-orbit maneuver. Complete next in the series of satellite design(s). Initiate procurement of bus and payload hardware.				
(U)				
(U) CONGRESSIONAL ADD: Integrated Spacecraft Engineering Tool (ISET). Note: In FY 2007, this Add has been moved to Project 632181, for execution.	0.969	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Integrated Spacecraft Engineering Tool (ISET).				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 3834 Integrated Space Technology Demonstrations

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Microsatellite Serial Manufacturing Process. Note: In FY 2007, this Add has been moved to Project 63682J, for execution.	1.355	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Microsatellite Serial Manufacturing Process.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.	0.969	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	27.241	27.461	28.929	32.147

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) C. Other Program Funding Summary ($ in Millions)

harmonize efforts and
eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4400 Space Systems Protection	3.369	3.439	4.958	6.039	6.798	6.867	7.744	7.907	Continuing	TBD
Quantity of RDT&E Articles	0	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 radio frequency (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 2006	FY 2007	FY 2008	FY 2009
(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.	0.783	0.825	1.191	1.450
(U) In FY 2006: Performed predicative analysis of laboratory data to validate models being developed for the satellite constellation analysis tool. Modeled mitigation techniques and incorporated into constellation analysis tool.				
(U) In FY 2007: Verify mitigation models against test data and commence predictive analysis of technique effectiveness.				
(U) In FY 2008: Conduct laboratory testing of candidate RF and Laser countermeasures and validate multi-threat assessment tool.				
(U) In FY 2009: Conduct demonstrations illustrating effects and meditation analysis. Identify technology transfer opportunities and report findings to major commands.				
(U)				
(U) MAJOR THRUST: Develop passive satellite countermeasures and mitigation techniques for current and future threats to satellites.	1.729	1.823	2.627	3.200
(U) In FY 2006: Selected the most promising defensive technology and began space experiment planning and integration. Identified potential of multiple-use technologies 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.				
(U) In FY 2008: Select the most promising detection and defensive technology and begin integration.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Conduct demonstrations of systems integration and performance.				
(U)	In FY 2009: Conduct mitigation technology space demonstration and post flight analysis.				
(U)					
(U)	MAJOR THRUST: Develop visible and near-infrared laser protection technologies.	0.857	0.791	1.140	1.389
(U)	In FY 2006: Demonstrated visible and near-infrared laser protection technologies. Conducted ground test of optical sensor subsystem incorporating selective mitigation approaches. Developed selected protection techniques and evaluate effectiveness as a laser mitigation technique of optical sensor subsystems. Coordinated 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)	In FY 2008: Develop selected protection techniques and coordinate space simulation testing of prospective protection technology. Qualify technology for application on space experiment for orbital demonstration.				
(U)	In FY 2009: Nominate "space qualified" technology and provide test unit to experimental satellite for integration.				
(U)	Total Cost	3.369	3.439	4.958	6.039

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603401F Advanced Spacecraft Technology**	**5021 Space Systems Survivability**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5021 Space Systems Survivability	4.428	4.806	4.866	5.292	5.489	5.571	5.684	5.808	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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.	3.043	3.671	3.683	4.066
(U) In FY 2006: Completed concept design for joint-agency space-based coronagraph and heliospheric imager for next-generation solar hazard detection system. Designed concept micro- and nano-technology sensors for energetic particle, neutral density, low-energy plasma space weather characterization.				
(U) In FY 2007: 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) In FY 2008: Continue construction of joint agency coronagraph and heliospheric imager for solar hazard detection. Continue development of miniaturized space weather sensor engineering models. Initiate program to test and evaluate empirical flare prediction models based on synoptic data from Air Force and national observatory assets.				
(U) In FY 2009: Continue construction of joint agency coronagraph and heliospheric imager for solar hazard detection. Complete development of miniaturized space weather sensor engineering models. Identify space test opportunity for miniaturized solar hazard sensors. Continue program to test and evaluate empirical flare prediction models based on synoptic data from Air Force and national observatory assets.				
(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	0.375	0.370	0.382	0.389

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603401F Advanced Spacecraft Technology**	PROJECT NUMBER AND TITLE **5021 Space Systems Survivability**

(U)	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	surveillance systems.				
(U)	In FY 2006: Developed space plasma control experiment plan combining satellite charge control and tether propulsion and particle remediation concepts. Integrated dynamic space particle climatology and radiation belt forecast models into spacecraft environment effect tool suite. Fabricated 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)	In FY 2008: Complete space plasma control experiment payload and begin calibration and integration onto Air Force test satellite. Complete spacecraft environment effect tool suite to include dynamic space particle climatologies and forecast models. Release tool suite to DoD community. Complete radiation belt remediation payload calibration and complete integration onto Air Force test satellite.				
(U)	In FY 2009: Launch space plasma control experiment payload on Air Force test satellite into orbit. Begin on-orbit checkout and in-flight calibration. Begin development of new medium earth orbit radiation belt model. Launch radiation belt remediation payload on Air Force test satellite into orbit. Begin on-orbit checkout and in-flight calibration.				
(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.	1.010	0.765	0.801	0.837
(U)	In FY 2006: Developed filter-based optimization algorithms to determine full particle energy spectra utilizing complete inputs available from compact environment anomaly sensor. Determined impact sensor design and finalize requirements and conceptual design of radiation, plasma, chemical, and impact effect distributed anomaly resolution and spacecraft effects sensor suite. Completed 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603401F Advanced Spacecraft Technology**	PROJECT NUMBER AND TITLE **5021 Space Systems Survivability**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	environment on Air Force test satellite.				
(U)	In FY 2008: Analyze data from compact environment anomaly sensor data bases and continue anomaly resolution for space system design. Continue construction of hardware for space demonstration of the distributed anomaly resolution sensor. Integrate compact environment anomaly sensor for diagnosing severe radiation environment on Air Force test satellite.				
(U)	In FY 2009: Continue construction of hardware for space demonstration of the distributed anomaly resolution sensor. Perform verification and validation of compact environment anomaly sensor for diagnosing- severe radiation environment.				
(U)	Total Cost	4.428	4.806	4.866	5.292

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	PE 0602601F, Spacecraft Technology.										
(U)	This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	0603401F Advanced Spacecraft Technology	5083 Ballistic Missiles Technology

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5083 Ballistic Missiles Technology	3.488	3.901	5.847	6.197	6.472	6.625	6.611	6.607	Continuing	TBD
Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(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.	1.744	1.951	2.924	3.099
(U) In FY 2006: Explored laboratory proof-of-concept of the most promising next generation missile navigation instrumentation designs. Fabricated initial navigation instruments and engineering demonstration units. Performed engineering development tests. Evaluated instrument performance and provided 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) In FY 2008: Continue next generation missile navigation system engineering development, design, and ground test in relevant strategic environments, and evaluate design improvements against established performance goals. Continue flight test demonstration planning. Initiate engineering system design verification and testing.				
(U) In FY 2009: Continue engineering system development design verification and testing to incorporate performance improvements. Conduct flight qualification testing and evaluation of candidate demonstration flight units. Initiate system integration of flight demonstration units with emerging vehicle designs.				
(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	1.744	1.950	2.923	3.098

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 5083 Ballistic Missiles Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	systems.				
(U)	In FY 2006: Developed long-term plan for sled testing of high-gravitational force tolerant navigation instrumentation and range safety devices. Characterized instrumentation performance in quiescent environments. Designed 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 with experimental test bed.				
(U)	In FY 2008: Complete test planning, integration, and conduct sled testing of high-gravitational force tolerant navigational instrumentation and range safety devices in preparation for future flight test demonstrations. Continue performance evaluation of navigation instrumentation and range safety devices with associated hardware and software interfaces in relevant dynamic and hostile environments. Validate system design refinements and initiate long-term plan for flight testing advanced navigational instrumentation and range safety devices with new vehicle designs.				
(U)	In FY 2009: Measure and evaluate performance of advanced navigation instrumentation and range safety devices from experimental test bed and sled testing. Continue long-term planning and initiate long-lead hardware acquisition for flight testing advanced navigational instrumentation and range safety devices with new vehicle design interfaces. Initiate qualification testing of designs against validated system level interfaces.				
(U)	Total Cost	3.488	3.901	5.847	6.197

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	PE 0601102F, Defense Research Sciences.										
(U)	PE 0602601F, Space Technology.										
(U)	PE 0603311F, Ballistic Missile Technology.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 5083 Ballistic Missiles Technology

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

(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 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603401F Advanced Spacecraft Technology**	**682J Spacecraft Vehicles**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
682J Spacecraft Vehicles	17.367	31.119	11.303	8.740	10.098	10.716	12.129	12.398	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: Funds for the FY 2007 Congressionally-directed Massively Parallel Optical Interconnects in the amount of $1.1 million were moved from this Project to PE 0603789F, C3I Advanced Development, Project 634216, for execution. Also, funds for the FY 2007 Congressionally-directed Advanced Satellite Thermal Control Program were moved from PE 0603211F, Aerospace Technology Development and Demonstration, Project 63486U, to this PE, for execution.

(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 2006	FY 2007	FY 2008	FY 2009
(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.	1.351	2.103	2.355	2.327
(U) In FY 2006: Completed space environmental testing of thin-film solar cells and modules. Performed 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) In FY 2008: Complete fabrication of flight hardware for Thin-Film Radiation Exposure flight experiment. Complete ground portion of on-orbit prediction model for thin-film solar cells. Develop interconnect technologies for advanced multijunction solar cell structures.				
(U) In FY 2009: Demonstrate greater than 14% efficient thin-film solar cells. Begin performance optimization of greater than 40% efficient solar cell concepts.				
(U)				
(U) MAJOR THRUST: Develop technologies for long life, efficient, low-vibration, lightweight mechanical cryocoolers and integration components for space applications.	0.878	1.482	1.330	1.044
(U) In FY 2006: Completed development of low temperature flight-qualified high capacity cryocooler and demonstrated performance of cryocooler and control electronics integrated with focal plane in a relevant environment. Improved performance of key critical components including compressor, electronics, and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	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 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)	In FY 2008: Complete design and begin development of a non moving parts compressor using proton biased membrane technology. Complete design and begin development of a low vibration conductance, cross gimbal 35 K cooling loop interface to support space tracking missions. Complete design and begin development of an improved thermal interface material doubling conductive transfer capacity in space cooling applications. Complete comprehensive study and begin technology development of satellite cryogenic interface requirements and improved technologies to support space tracking applications.				
(U)	In FY 2009: Continue development of a non moving parts compressor using proton biased membrane technology. Continue development of a low vibration conductance, cross gimbal 35 K cooling loop interface to support space tracking missions. Continue development of an improved thermal interface material doubling conductive transfer capacity in space cooling applications. Continue technology development of satellite cryogenic interface requirements and improved technologies to support space tracking 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. Note: In FY 2008, increase in funding is due to acceleration of the thermal management testbed program.	1.659	3.657	5.229	2.965
(U)	In FY 2006: Developed ultra-lightweight, high-structural efficiency mirror support structures for space mirrors. Demonstrated 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)	In FY 2008: Develop symbiotic structural technologies for large deployable structural sensors and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	improved thermal management sensors. Perform flight-qualification tests of novel deployable structure architectures, cryogenic tanks, and launch vehicle structural components. Develop thermal management testbed.				
(U)	In FY 2009: Fly elastically-deployed, stored strain energy, deployable structural architectures including shape memory alloy reinforced hinges. Develop and test thermal management hardware.				
(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.	1.666	2.857	2.389	2.404
(U)	In FY 2006: Developed rapid-slew, fast tracking gimbal technology to allow sub-orbital space situational awareness missions. Demonstrated 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)	In FY 2008: Implement estimation algorithm for improved local situational awareness using on existing on-orbit asset.				
(U)	In FY 2009: Begin implementation of advanced estimation algorithms for improved local situational awareness onto flight hardware prototype under development.				
(U)					
(U)	CONGRESSIONAL ADD: Beta Energy Cells (BEC) for Defense and Intelligence Applications.				
(U)	In FY 2006: Conducted Congressionally-directed effort for Beta Energy Cells (BEC) for Defense and Intelligence Applications.	4.067	0.000	0.000	0.000
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Thin Film Amorphous Solar Arrays.	3.873	10.361	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Thin Film Amorphous Solar Arrays.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Thin Film Amorphous Solar Arrays.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603401F Advanced Spacecraft Technology**	PROJECT NUMBER AND TITLE **682J Spacecraft Vehicles**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Large Automated Production of Expendable Launch Structure (LAPELS).	3.873	2.590	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for LAPELS.				
(U)	In FY 2007: Conduct Congressionally-directed effort for LAPELS.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Information Sciences Institute Microsatellite Serial Manufacturing Demonstration Program.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Information Sciences Institute Microsatellite Serial Manufacturing Demonstration Program.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Microsatellite Serial Manufacturing. Note: This Add has been previously executed in Project 633834.	0.000	1.992	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Microsatellite Serial Manufacturing.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Photovoltaic Module Development for Lighter than Air Vehicles.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Photovoltaic Module Development for Lighter than Air Vehicles.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603401F Advanced Spacecraft Technology**	PROJECT NUMBER AND TITLE **682J Spacecraft Vehicles**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	CONGRESSIONAL ADD: Small Low-Cost Reconnaissance Spacecraft.	0.000	1.096	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Small Low-Cost Reconnaissance Spacecraft.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Space Situational Awareness/Star Tracking System.	0.000	1.594	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Space Situational Awareness/Star Tracking System.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Satellite Thermal Control Program.	0.000	1.395	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Advanced Satellite Thermal Control Program.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	17.367	31.119	11.303	8.740

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

Innovative Technologies.

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2007

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603444F MAUI SPACE SURVEILLANCE SYSTEM

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	45.943	50.383	5.237	5.338	6.773	6.888	6.025	6.179	Continuing	TBD
4868 Maui Space Surveillance System	45.943	50.383	5.237	5.338	6.773	6.888	6.025	6.179	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 2007, Congress added $8.0 million for the High Accuracy Network Determination System (HANDS), $25.0 million for MSSS Operations and Research, and $11.5 million for the Panoramic Survey Telescope and Rapid Response System (PanSTARRS). 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 2006	FY 2007	FY 2008	FY 2009
(U) Previous President's Budget	47.166	6.074	6.173	6.699
(U) Current PBR/President's Budget	45.943	50.383	5.237	5.338
(U) Total Adjustments	-1.223			
(U) Congressional Program Reductions				
Congressional Rescissions	-0.001	-0.191		
Congressional Increases		44.500		
Reprogrammings	-0.016			
SBIR/STTR Transfer	-1.206			

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics
Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE **February 2007**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603444F MAUI SPACE SURVEILLANCE SYSTEM**	**4868 Maui Space Surveillance System**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4868 Maui Space Surveillance System	45.943	50.383	5.237	5.338	6.773	6.888	6.025	6.179	Continuing	TBD
Quantity of RDT&E Articles	0	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 2007, Congress added $8.0 million for the High Accuracy Network Determination System (HANDS), $25.0 million for MSSS Operations and Research, and $11.5 million for the Panoramic Survey Telescope and Rapid Response System (PanSTARRS). 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 2006	FY 2007	FY 2008	FY 2009
(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 $25.0 million in FY 2007.	26.732	30.957	5.237	5.338

(U) In FY 2006: Continued MSSS operations, research, and development supporting various operational customers and experimenters, with the focus on space situational awareness (SSA). Procured additional critical sensor and telescope spares, continued to refurbish the control rooms and upgrade computers for increased efficiency, while maintaining requirements for safety and security in accordance with Air Force regulations. Significantly improved computational imaging technology and demonstrated the best-ever ground-to-space image of an operational satellite. Established techniques for defining the absolute performance limits of imaging systems. These techniques are being transitioned to a variety of optical system designers within the Department of Defense (DoD), as well as academia.

(U) In FY 2007: Continue MSSS research, and development, and operational contributions supporting various operational customers and experimenters. Continue refurbishing and upgrading MSSS, and maintaining requirements for safety and security in accordance with Air Force regulations. Develop concepts for SSA, space system characterization, and active tracking. Assess military utility, optimize mission effectiveness, and evaluate transition opportunities of technology to Air Force Space Command. Initiate development of a state-of-the-art, high-performance sodium beacon adaptive optics system. Continue development of high performance and ultra-precise astrodynamics techniques. Continue to identify unique electro-optical phenomenologies that can cost-effectively provide health/status, identification, and anomaly resolution for satellite owner/operators.

(U) In FY 2008: Continue MSSS research, development, and operational contributions supporting various

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	customers and experimenters. Continue refurbishing and upgrading MSSS, and maintaining requirements for safety and security in accordance with Air Force regulations. Develop concepts for SSA, space system characterization and active tracking. Continue development of a state-of-the-art, high-performance sodium beacon adaptive optics system.				
(U)	In FY 2009: Continue MSSS research, development, and operational contributions supporting various customers and experimenters. Continue refurbishing and upgrading MSSS to accommodate those missions, and maintaining requirements for safety and security in accordance with Air Force regulations. Develop concepts for SSA, space system characterization, and active tracking. Continue development of a state-of-the-art, high-performance sodium beacon adaptive optics system.				
(U)					
(U)	CONGRESSIONAL ADD: Panoramic Survey Telescope And Rapid Response System (Pan-STARRS).	9.605	11.456	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Pan-STARRS.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Pan-STARRS.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: High Accuracy Network Determination System (HANDS).	9.606	7.970	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for HANDS.				
(U)	In FY 2007: Conduct Congressionally-directed effort for HANDS.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	Total Cost	45.943	50.383	5.237	5.338

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	Related Activities:										
(U)	PE 0602605F, Directed Energy Technology.										
(U)	PE 0603605F, Advanced Weapons Technology.										
(U)	PE 0602500F,										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)**

Multi-Disciplinary Space Technology.

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space 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-2, RDT&E Budget Item Justification

DATE: **February 2007**

BUDGET ACTIVITY
03 Advanced Technology Development (ATD)

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

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	51.929	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5031	Advanced Optics & Laser Space Tech	19.938	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5033	Rocket Propulsion Demonstration	25.066	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5034	Advanced Space Sensors	6.925	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2007, Project 635031 efforts transfer to PE 0603605F, Project 6311SP, Advanced Optics and Laser Space Technology; Project 635032 efforts transfer to PE 0603112F, Advanced Materials for Weapons Systems, Project 6377SP, Advanced Space Materials; Project 635033 efforts transfer to PE 0603216F, Aerospace Propulsion and Power Technology, Project 6310SP, Space Rocket Propulsion Demonstration; Project 635034 efforts transfer to PE 0602203F, Advanced Aerospace Sensors, Project 6388SP, Advanced Space Sensors; and Project 635062 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. 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 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	55.732	0.000	0.000	0.000
(U)	Current PBR/President's Budget	51.929	0.000	0.000	0.000
(U)	Total Adjustments	-3.803			
(U)	Congressional Program Reductions				
	Congressional Rescissions	0.028			
	Congressional Increases				
	Reprogrammings	-2.595			
	SBIR/STTR Transfer	-1.236			

(U) Significant Program Changes:

Efforts transfer to other programs in FY 2007 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 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5031	Advanced Optics & Laser Space Tech	19.938	0.000	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	0		

Note: 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 2006	FY 2007	FY 2008	FY 2009
(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. .	2.916	0.000	0.000	0.000
(U) In FY 2006: Planned 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. Demonstrated the ability to apply advanced high energy laser optical coatings on a three-meter diameter substrate such as lightweight silicon carbide primary mirrors. Designed and built a lightweight mirror/micro electro-mechanical system integration testbed for the evaluation of advanced optical components.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) MAJOR THRUST: Perform atmospheric compensation/beam control experiments for applications including relay mirror systems, satellite tests and diagnostics, and high-resolution satellite imaging.	4.707	0.000	0.000	0.000
(U) n FY 2006: Tested advanced laser-beacon adaptive optics system on Starfire Optical Range 3.5 meter telescope to increase imaging resolution/laser beam control. Performed high-resolution satellite imaging at short wavelengths. Demonstrated and characterized performance of point-ahead compensated laser propagation to low-earth-orbit (LEO) satellites using sodium-beacon adaptive optics.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate advanced optical beam control technologies for laser propagation through severe and/or extended atmospheric turbulence.	12.315	0.000	0.000	0.000
(U)	In FY 2006: Completed integration of first phase ground test system for characterization of laser propagation through atmospheric turbulence. Completed laboratory experiments and field tested advanced adaptive optical and tracking technologies in stressing atmospheric conditions.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	Total Cost	19.938	0.000	0.000	0.000

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5033 Rocket Propulsion Demonstration	25.066	0.000	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	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch vehicles.	13.388	0.000	0.000	0.000
(U) In FY 2006: Scaled-up and tested advanced lightweight thrust chamber and nozzle technologies. Scaled-up advanced cryogenic upper stage technologies including higher efficiency energy conversion systems.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: 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.	3.588	0.000	0.000	0.000
(U) In FY 2006: Developed electric propulsion systems for orbit-transfer by developing high-power Hall				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	thrusters capable of low-earth-orbit geosynchronous-earth-orbit transfer. Developed components for the high-power Hall thruster demonstration.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: 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. Note: Efforts completed in FY 2006.	6.321	0.000	0.000	0.000
(U)	In FY 2006: Completed fabrication of final components for the final strategic sustainment demonstration motors and prepared for test. Completed assessment and fabrication of the final strategic sustainment demonstration motors.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop electric and advanced chemical based monopropellant propulsion technologies for future satellite propulsion systems.	0.806	0.000	0.000	0.000
(U)	In FY 2006: Completed advanced monopropellant thruster demonstration.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Upper Stage Engine Technology (USET).	0.963	0.000	0.000	0.000
(U)	In FY 2006: Provided 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	25.066	0.000	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE **February 2007**

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC**	**5034 Advanced Space Sensors**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5034 Advanced Space Sensors	6.925	0.000	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	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop and demonstrate technologies to maximize Global Positioning System jam resistance, positional accuracy, timing accuracy, and exploitation techniques to improve offensive and defensive combat capabilities.	2.129	0.000	0.000	0.000
(U) In FY 2006: Designed space-based distributed position, navigation, and time technologies to achieve optimal sensor fusion for a Common Operation Picture. Designed multi-ship virtual flight test simulation technology to assess networked clusters of mini" unmanned aerial vehicles.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(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.	1.600	0.000	0.000	0.000
(U) In FY 2006: Integrated false alarm package space-flight components onto space flight host. Planned and coordinated on-orbit testing, data collection, and system evaluation. Developed risk-reduction technology for space-qualified laser warning sensors for rapid detection and characterization of laser designators, trackers, dazzlers, and weapons. Completed development of a space-based laser threat scenario testbed for satellite-as-a-sensor technology evaluations.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: 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).	2.877	0.000	0.000	0.000
(U)	In FY 2006: Developed an integrated electro-optical communication terminal for evaluation and testing of AISR links between an airborne communication testbed and ground terminals. Developed shared radio frequency/electro-optical apertures to service high bandwidth communication needs. Tested applicability of shared apertures to maintaining air network link connectivity under in weather conditions. Installed 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. Demonstrated a combined radio frequency/ optical communication air to air to ground high bandwidth network.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(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.	0.319	0.000	0.000	0.000
(U)	In FY 2006: Designed a testbed sensor to evaluate the performance potential of spectral-temporal sensing for battlespace surveillance missions. Modeled expected performance for a variety of targets, including muzzle flashes, artillery and tank fire, and battlefield explosions.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	6.925	0.000	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) C. Other Program Funding Summary ($ in Millions)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

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Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE
0603601F Conventional Weapons Technology

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	35.916	38.512	16.904	13.794	22.140	21.606	19.153	18.929	Continuing	TBD
670A	Conventional Weapons Development	35.916	38.512	16.904	13.794	22.140	21.606	19.153	18.929	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 2007, Congress added $2.0 million for Falcon Eye Seeker; $1.4 million for Micro-Sized Air-Launched Atmospheric Visibility Sensor; $1.4 million for Air Force Special Ops Innovative Miniature Infrared Camera; $3.2 million for the Clandestine Electric Reconnaissance Vehicle (CERV) for AFSOC; $1.4 million for the Ground Mobile Gateway System; $3.6 million for Under Vehicle Mobile Inspection; $3.2 million for Next Generation Fixed Wing S-3B Heavy Aerial Firefighting Tanker; $1.4 million for UAV Sensor Interface and Payloads for Targeting; and $1.4 million for Weapons Data Link. 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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	30.519	19.658	19.993	21.504
(U)	Current PBR/President's Budget	35.916	38.512	16.904	13.794
(U)	Total Adjustments	5.397			
(U)	Congressional Program Reductions				
	Congressional Rescissions	0.023	-0.146		
	Congressional Increases		20.400		
	Reprogrammings	5.917	-1.400		
	SBIR/STTR Transfer	-0.543			

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
670A	Conventional Weapons Development	35.916	38.512	16.904	13.794	22.140	21.606	19.153	18.929	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(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 2007, Congress added $2.0 million for Falcon Eye Seeker; $1.4 million for Micro-Sized Air-Launched Atmospheric Visibility Sensor; $1.4 million for Air Force Special Ops Innovative Miniature Infrared Camera; $3.2 million for the Clandestine Electric Reconnaissance Vehicle (CERV) for AFSOC; $1.4 million for the Ground Mobile Gateway System; $3.6 million for Under Vehicle Mobile Inspection; $3.2 million for Next Generation Fixed Wing S-3B Heavy Aerial Firefighting Tanker; $1.4 million for UAV Sensor Interface and Payloads for Targeting; and $1.4 million for Weapons Data Link. 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.

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(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.	4.055	3.768	3.399	3.442
(U)	In FY 2006: Designed a hard target influence fuze capable of denying hard and deeply buried facilities access. Developed 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)	In FY 2008: Complete initial phase of hard target influence fuze development and testing. Begin developing an active imaging target device that can provide warhead aimpoint selection for mass focused warheads.				
(U)	In FY 2009: Continue developing an active imaging target device that can provide warhead aimpoint selection for mass focused warheads.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate conventional munition subsystem and platform	1.875	0.241	0.312	1.400

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	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.				
(U)	In FY 2006: Integrated a miniaturized datalink into a weapon system to perform retargeting in-flight. Planned a datalink flight demonstration. Planned a low-cost miniature cruise missile demonstration. Planned a miniature persistent munition demonstration that will provide area dominance with a multiple-shot capability.				
(U)	In FY 2007: Complete 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)	In FY 2008: Begin development of a small powered short-range precision-guided submunition capable of attacking multiple moving targets.				
(U)	In FY 2009: Develop a small powered short-range precision-guided submunition capable of attacking multiple moving targets. Begin developing a missile with the capability to defeat a broad range of small and highly agile air targets as well as high value ground targets, such as enemy as air defenses.				
(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.	14.068	6.751	7.063	3.433
(U)	In FY 2006: Improved insensitive explosive warhead fills with a goal to significantly reduce the fill volume completing the intended ordnance mission. Developed an ordnance package to significantly improve counter-air lethality against cruise missiles and manned aircraft. Designed a multi-mode warhead package designed for precision-guided submunitions. Developed a weapon system capable of dispensing payloads within a target for counterforce applications. Test and develop an ordnance package designed for low collateral damage and minimum far-field lethality.				
(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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	lethality against cruise missiles and manned aircraft. Develop and test systems needed for an ordnance package with low collateral damage and minimum far-field lethality. 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)	In FY 2008: Extend development of an ordnance package with improved counter-air lethality to address cruise missile and urban targets, as well as attacking a subset of ground targets to include enemy air defenses. Continue developing a multi-mode warhead package designed for precision guided submunitions.				
(U)	In FY 2009: Demonstrate of an ordnance package with improved counter-air lethality to address cruise missile and counter-air targets, as well as attacking a subset of ground targets to include enemy air defenses. Demonstrate a multi-mode warhead package designed for precision guided submunitions.				
(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: In FY 2006 and prior, 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.	0.000	7.629	6.130	5.519
(U)	In FY 2006: Not Applicable.				
(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. Develop ordnance package designed for low collateral damage and minimum far-field lethality.				
(U)	In FY 2008: Continue design and demonstration of low cost laser detection and ranging seeker to increase data rates and reduce moving parts compared to earlier generation laser seeker technologies. Develop a multi-mode radar seeker capable of engaging both moving and stationary targets in adverse weather.				
(U)	In FY 2009: Continue design and demonstration of a low cost laser detection ordnance seeker to increase data rates and LADAR moving parts compared to earlier generation LADAR seeker				

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	technologies. Flight test a multi-mode radar seeker capable of engaging both moving and stationary targets in adverse weather.				
(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).	5.664	1.626	0.000	0.000
(U)	In FY 2006: Developed and demonstrated 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. Developed 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)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: High Speed Strike Weapon.	2.805	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for High Speed Strike Weapon.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Fuze Air-to-Surface Technology (FAST).	0.967	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for FAST.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Internet Protocol (IP) Targeting Extension System.	0.967	0.000	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603601F Conventional Weapons Technology**	PROJECT NUMBER AND TITLE **670A Conventional Weapons Development**

(U)	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2006: Conducted Congressionally-directed effort for IP Targeting Extension System.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Plug and Play Capability for Air-Launched Weapons.	0.967	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Plug and Play Capability for Air-Launched Weapons.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Air Force Special Ops Innovative Miniature Infrared Camera.	1.258	1.363	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Air Force Special Ops Innovative Miniature Infrared Camera.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Air Force Special Ops Innovative Miniature Infrared Camera.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Clandestine Electric Reconnaissance Vehicle (CERV) for Air Force Special Operations Command (AFSOC).	1.645	3.116	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for CERV for AFSOC.				
(U)	In FY 2007: Conduct Congressionally-directed effort for CERV for AFSOC.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Micro-Sized Air-Launched Atmospheric Visibility Sensor.	1.645	1.363	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Micro-Sized Air-Launched Atmospheric Visibility Sensor.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Micro-Sized Air-Launched Atmospheric				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	Visibility Sensor.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Falcon Eye Seeker	0.000	1.947	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effert for Falcon Eye Seeker.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Ground Mobile Gateway System.	0.000	1.363	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Ground Mobile Gateway System.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Under Vehicle Mobile Inspection.	0.000	3.503	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Under Vehicle Mobile inspection System.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Next Generation Fixed Wing S-3B Heavy Aerial Firefighting Tanker	0.000	3.116	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Next Generation Fixed Wing S-3B Heavy Aerial Firefighting Tanker.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Unmanned Air Vehicle (UAV) Sensor Interface and Payloads for Targeting.	0.000	1.363	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603601F Conventional Weapons Technology**	PROJECT NUMBER AND TITLE **670A Conventional Weapons Development**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for UAV Sensor Interface and Payloads for Targeting.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Weapons Data Link.	0.000	1.363	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Weapons Data Link.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	35.916	38.512	16.904	13.794

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602602F, Conventional Munitions.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE
0603605F Advanced Weapons Technology

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	42.124	76.733	43.999	38.877	72.809	57.427	64.922	76.273	Continuing	TBD
11SP	Advanced Optics and Laser Space Tech	0.000	21.323	21.107	18.296	27.505	27.982	28.011	28.875	0.000	0.000
3150	Advanced Optics Technology	10.226	11.955	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
3151	High Power Solid State Laser Technology	13.240	26.650	12.388	11.428	21.669	16.932	23.569	32.552	Continuing	TBD
3152	High Power Microwave Technology	10.170	12.890	10.504	9.153	23.635	12.513	13.342	14.846	Continuing	TBD
3647	High Energy Laser Technology	8.488	3.915	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: 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.

(U) **A. Mission Description and Budget Item Justification**

This program provides for the development and demonstration of advanced directed energy and optical concepts. In solid state lasers, compact, reliable, relatively high power, cost-effective single electric laser devices and arrays of electric laser devices are demonstrated. Technologies such as high power chemical lasers and beam control are also demonstrtaed. In high power microwaves, technologies such as narrowband and wideband devices and antennas are demonstrated. Note: In FY 2007, Congress added $6.8 million for Applications of LIDAR to Vehicles with Analysis (ALVA), $1.6 million for the Near Earth Space Surveillance Initiative, $1.0 million for Mobile Active Targeting Resource for Integrated Experiments, $2.0 million Laser Spark System Integration, $1.7 million for Mid-Infrared Semiconductor Laser Technology, $2.4 million for High Energy Laser - Directed Energy Weapon (HEL-DEW) Scaling Optimization, $1.0 million for the Hyper/multispectral Data Reduction and Archiving (HyDRA) Project, $2.6 million for Advanced Weapons and Laser Diode Development, $5.0 million for Lightweight Multi-purpose Laser, and $1.6 million for Real-time Optical Surveillance Applications. 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 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603605F Advanced Weapons Technology**

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

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	49.821	51.336	51.057	53.351
(U)	Current PBR/President's Budget	42.124	76.733	43.999	38.877
(U)	Total Adjustments	-7.697			
(U)	Congressional Program Reductions		-0.012		
	Congressional Rescissions	-0.032	-0.291		
	Congressional Increases		25.700		
	Reprogrammings	-6.629			
	SBIR/STTR Transfer	-1.036			

(U) Significant Program Changes:

In FY 2006, $4.284 million was reporgrammed into PE 0602890F, High Energy Laser Research, as the Air Force contribution to the Joint High Power Solid State Laser program.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
11SP	Advanced Optics and Laser Space Tech	0.000	21.323	21.107	18.296	27.505	27.982	28.011	28.875	0.000	0.000
	Quantity of RDT&E Articles	0	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 and laser systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop and demonstrate 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.	0.000	1.186	1.060	1.137
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Perform cost trade studies and begin design of integrated testbed.				
(U) In FY 2008: Begin integration of advanced optical technoplogies in an optical testbed and design sub-systems such as power, advanced thermal management, signal processing, sensors, and optical mounting and vibration control.				
(U) In FY 2009: Continue integration of testbed and begin testing of sub-systems.				
(U)				
(U) MAJOR THRUST: Perform atmospheric compensation/beam control experiments for space situational awareness applications using large aperture telescopes, including high-resolution satellite imaging, detection and characterization of small/dim space objects, and high accuracy space object tracking.	0.000	5.578	4.317	3.822
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Demonstrate detection and discrimination of small, non-resolved space objects. Demonstrate near-infrared imaging of satellites too small or dim for present systems. Begin integration of high efficiency adaptive optics system for compensated visible imaging and detection of very dim space objects. Demonstrate phased array imaging for large aperture high resolution telescopes.				
(U) In FY 2008: Continue integration of high efficiency adaptive optics system for compensated imaging and detection of very dim space objects at visible wavelengths. Perform laboratory tests to validate the performance of lightweight mirrors				
(U) In FY 2009: Integrate high efficiency adaptive optics system on large aperture high resolution				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	telescope. Demonstrate compensated imaging and detection of very dim space objects at visible wavelengths. Conclude phased array imaging experiments.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate advanced optical beam control technologies for laser propagation through severe and/or extended atmospheric turbulence.	0.000	14.559	15.730	13.337
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Begin integration of advanced ground diagnostic system for characterization of laser propagation through atmospheric turbulence. Demonstrate and characterize operation of advanced adaptive optics and tracking technologies in stressing atmospheric conditions.				
(U)	In FY 2008: Continue integration of advanced ground diagnostic system for characterization of laser propagation through stressing atmospheric turbulence. Perform laboratory characterization on components for sensing and wavefront control technologies.				
(U)	In FY 2009: Complete integration of advanced ground diagnostic system performance in a variety of atmospheric conditions. Complete characterizaton and demonstration of advanced sensing and wavefront control technologies.				
(U)	Total Cost	0.000	21.323	21.107	18.296

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U)	PE 0602605F, Directed Energy Technology										
(U)	PE 0603444F, Maui Space Surveillance System										
(U)	PE 0603883C, Ballistic Missile Defense Boost Phase Segment										
(U)	This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603605F Advanced Weapons Technology**	**3150 Advanced Optics Technology**

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3150 Advanced Optics Technology	10.226	11.955	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	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 2006	FY 2007	FY 2008	FY 2009
(U) CONGRESSIONAL ADD: Satellite Active Imaging National Testbed Program.	1.061	0.000	0.000	0.000
(U) In FY 2006: Demonstrated the beam rotator, a key transmitter component; performed piston jitter measurements for the telescope design; demonstrated and characterized a 50 watt fiber laser; performed detector characterizations for receiver development; and analyzed initial results for a 22-channel beam combiner.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Near Earth Space Surveillance Initiative (NESSI).	1.736	1.594	0.000	0.000
(U) In FY 2006: Began development of the Visible Integrated-field Replicable Unit Spectrograph. Continued sensing and optical design work as well as structural and optical refurbishment for the Charge Coupled Device/Transit Instrument-II system. Continued design of the focal plane mosaic.				
(U) In FY 2007: Complete design and fabricate the Wide Field Corrector. Conduct design studies for the Prime Focus Instrument Package and the Tracker. Complete Charge Coupled Device/Transit Instrument-II system site determination and fabricate of the lens and dome.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Applications of LIDAR to Vehicles with Analysis (ALVA).	5.789	6.775	0.000	0.000
(U) In FY 2006: Designed a three-dimensional capability for imaging/detection of small/dim targets. Designed and built a sensor for first kilowatt-class laser radar system on Maui for space situational awareness and missile tracking applications. Demonstrated precision satellite handover capability using high-accuracy metrics. Demonstrated the improved laser radar for deep space metric and space object identification missions, microsat tracking, and ballistic missile defense discrimination. Investigated				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	eye-safe laser radars and showed increased battlefield information in combat identification, battle damage assessment, and camouflage penetration. Integrated laser radar and sensors into an operational airborne turret ball for transition to the warfighter.				
(U)	In FY 2007: Develop airborne night-time imaging for counter-improvised explosive device (IED) and operational intelligence and targeting. Integrate, flight test, and evaluate military utility lasers for nighttime video. Develop low-power photon-counting laser radar for small and/or dim object tracking, characterization, and imaging. Develop high-speed ranging and radiometry capabilities.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Mobile Active Targeting Resource for Integrated Experiments.	1.640	0.996	0.000	0.000
(U)	In FY 2006: Completed wavefront measurement preparations. Obtained aero-optics aircraft measurement hardware; began preparations for use of software and hardware on test aircraft. Began integration of Hemispherical Optical Sensing and Tracking system.				
(U)	In FY 2007: Demonstrate self-contained capability to optically acquire and track man portable air defense system (MANPADS) missiles. Provide testbed and risk reduction capabilities at low power for force protection applications. Measure and analyze aircraft platform vibration disturbances for future integration of high-energy laser weapons.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Real-time Optical Surveillance Applications.	0.000	1.594	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Real-time Optical Surveillance Applications.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Hyper/multispectral Data Reduction and Archiving (HyDRA) Project.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for the HyDRA Project.				
(U)	In FY 2008: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603605F Advanced Weapons Technology**	PROJECT NUMBER AND TITLE **3150 Advanced Optics Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	10.226	11.955	0.000	0.000

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0603444F, Maui Space Surveillance Systems.										
(U) PE 0602605F, Directed Energy Technology.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3151	High Power Solid State Laser Technology	13.240	26.650	12.388	11.428	21.669	16.932	23.569	32.552	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project provides for the development, integration, demonstration, and detailed assessment of low to high power laser and beam control technologies needed for aircraft protection, force protection, force application, precision engagement, and Global War on Terrorism missions. Critical technologies developed and demonstrated include: (1) compact, reliable, and affordable laser devices with good beam quality and scalability to high power; (2) advanced optics and laser beam control components to effectively compensate and propagate laser radiation through the atmosphere to a target. Emphasis will be on demonstrating the ability to meet key system concept performance parameters, reliability, affordability, and packaging requirements unique to potential applications. Perform laser system concept assessments to include vulnerability assessments and target effect testing. Identify critical design data for laser system concepts. Develop high energy laser system concepts and identify issues relating to system concept architectures, technology readiness, technology tradeoffs, mission effectiveness, and military utility.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop, integrate, and demonstrate solid state, advanced chemical, gas, and hybrid laser technology for scalable, high energy laser devices for insertion into airborne tactical and strategic applications and ground-based laser system concepts.	3.042	3.789	1.022	0.315

(U) In FY 2006: Benchmarked 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. Began development of a solid state laser that is scalable to the weapons-class level. Enhanced laser sources to detect, track, and classify tactical targets. Began development of a laser for eventual use on an airborne tactical platform to defeat next generation air-to-air threats. Developed a beam director that has the capability of handling a sensor-killer laser, while retaining all of the infrared countermeasures and search functions.

(U) In FY 2007: Continue scaling solid state lasers with a goal of reaching weapons-class power, beam quality, run time, etc. levels. 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 investigating tactical laser applications. Demonstrate tactical laser utility through field experiments and customer interaction.

(U) In FY 2008: Scale solid state lasers for tactical weapons and defense, with a goal of exceeding the

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	thresholds for weapons-class power, beam quality, and run time capabilities. Focus on reduction of size and weight, as well as increase in efficiency, affordability, reliability, maintainability, supportability, operational environmental acceptability, and ruggedness. Continue integrating 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. Test overall chemical laser device-level performance and work issues based on the integration of the ejector nozzle concepts, increased mass flow singlet-oxygen generators, and advanced fuels into a laser device.				
(U)	In FY 2009: Build and evaluate solid state lasers for tactical weapons and defense that exceed the thresholds for weapons-class power, beam quality, and run time capabilities. Continue to focus on reducing size and weight, as well as increasing efficiency, affordability, reliability, maintainability, supportability, operational environmental acceptability, and ruggedness. Further integrate 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 to evaluate overall chemical laser device-level performance and issues based on the integration of improved ejector nozzle concepts, increased mass flow singlet-oxygen generators, and advanced fuels into a laser device.				
(U)					
(U)	MAJOR THRUST: Develop, integrate, and demonstrate advanced optical and imaging technologies for advanced systems concepts. Technologies include optical components, optical coatings, advanced beam control, atmospheric compensation, and pointing and tracking. Develop and analyze system concepts and perform advanced critical experiments integrating laser and beam control technologies.	2.506	11.464	11.366	11.113
(U)	In FY 2006: Prepared lasers and their gimbals for day-night electro-optical tracker countermeasures advanced technology demonstration. Perform assessments to determine laser and support requirements for integrated high energy laser.				
(U)	In FY 2007: Begin integration experiments to focus on architectures favorable in terms of size, weight, efficiency, affordability, reliability, maintainability, supportability, operational environmental acceptability, and ruggedness for tactical weapon applications. Begin facility and support equipment modifications for integrated high energy laser.				
(U)	In FY 2008: Begin acquisition of a solid state laser to meet program specifications for integrated high energy laser testbed. Begin to upgrade existing facilities, integrate device and conduct initial testbed checkout. Demonstrate advanced tactical beam control hardware components in the laboratory.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	Analyze advanced beam control concepts in integrated simulations.				
(U)	In FY 2009: Continue integrated high energy laser component acquisition, integration and testing to evaluate testbed performance objectives against multiple applications. Initiate next spiral of system upgrades. Integrate advanced tactical beam control hardware components in the laboratory and validate performance predictions. Enhance advanced beam control system concepts and develop integrated system requirements.				
(U)					
(U)	CONGRESSIONAL ADD: Low Speed Airspeed System.	3.352	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Low Speed Airspeed System.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Wafer Integrated Semiconductor Laser.	1.929	0.000	0.000	0.000
(U)	In FY 2006: Continued toward the goal of lower cost/watt for solid state lasers by improving growth and processing to increase yield and thus cut costs, and by enhancing device layout and packaging to improve reliability.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable				
(U)					
(U)	CONGRESSIONAL ADD: High Brightness Laser Diode Source for Fiber Laser Pumps.	2.411	0.000	0.000	0.000
(U)	In FY 2006: Focused on further development of wavelength stabilization techniques, improved fiber-coupling packaging concepts, and refinement of manufacturing processes for better performance at lower cost.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Mid-Infrared Semiconductor Laser Technology.	0.000	1.656	0.000	0.000
(U)	In FY 2006: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2007: Conduct Congressionally-directed effort for Mid-Infrared Semiconductor Laser Technology.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: High Energy Laser- Directed Energy Weapon (HEL-DEW) Scaling Optimization.	0.000	2.338	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007; Conduct Congressionally-directed effort for HEL-DEW Scaling Optimization.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Weapons and Laser Diode Development.	0.000	2.533	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Advanced Weapons and Laser Diode Development.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Lightweight Multi-purpose Laser.	0.000	4.870	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Lightweight Multi-purpose Laser.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	13.240	26.650	12.388	11.428

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602102F, Materials.										
(U) PE 0603270F, Electronic										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)**

Combat Technology.

(U) PE 0602605F, Directed Energy Technology.

(U) PE 0601108F, High Energy Laser Research Initiatives.

(U) PE 0602890F, High Energy Laser Research.

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

(U) PE 0602120A, Sensors and Electronic Survivability.

(U) PE 0602307A, Advanced Weapons Technology.

(U) PE 0602624A, Weapons and Munitions Technology.

(U) PE 0603004A, Weapons and Munitions Advanced Technology.

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

(U) PE 0603175C, Ballistic Missile Defense Technology

(U) PE 0605799D8Z, Force Transformation

(U) PE 0603941D8Z, Test and Evaluation/Science and Technology

(U) This project has been coordinated through the Reliance 21 process to

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)

harmonize efforts and eliminate duplication.

(U) The technology efforts in this PE that are supporting future enhancements to airborne lasers have been coordinated with the Airborne Laser program office.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603605F Advanced Weapons Technology**	**3152 High Power Microwave Technology**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3152	High Power Microwave Technology	10.170	12.890	10.504	9.153	23.635	12.513	13.342	14.846	Continuing	TBD
	Quantity of RDT&E Articles	0	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 2006	FY 2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Conduct effects experimentation to expand and refine data library and support susceptibility predictions. Investigate and develop technologies for HPM airfield defense. Note: Due to higher Air Force priorities this thrust is being temporarily terminated in FY 2009.	0.737	0.948	0.594	0.000
(U)	In FY 2006: Began transitioning 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: Continue high power microwave effects tests to improve HPM system design and lethality. 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 develop techniques to mitigate vulnerabilities of U.S. infrastructure to HPM attack. Investigate electromagnetic interference/electromagnetic compatibility sub-system and system interface issues.				
(U)	In FY 2008: Refine airfield defense technologies. Evaluate components as appropriate.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop and evaluate millimeter-wave active denial technologies for non-lethal, anti-personnel weapon applications such as ground force protection from a stand off aircraft.	4.237	5.886	3.768	4.626
(U)	In FY 2006: Completed support of user operation/testing/demonstration of first ground-based				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603605F Advanced Weapons Technology**	PROJECT NUMBER AND TITLE **3152 High Power Microwave Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	development spiral product. Developed and evaluated technologies for non-lethal weapons applications. Continued the development of high power millimeter-wave source for airborne applications. Completed computational physics simulations of millimeter-wave sources against the draft detailed design drawings for the coaxial source approach. Performed cold testing for conventional source hardware followed by progression towards final source assembly. 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 2007: Develop and evaluate technologies for non-lethal weapons applications. Continue the development of high power millimeter-wave source for airborne applications. Evaluate first phase conventional source approach. Identify deficiencies and evaluate need to rebuild. Complete critical design review for coaxial source design or proceed on coaxial insert risk reduction step towards coaxial approach. 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)	In FY 2008: Continue to develop and evaluate technologies for non-lethal weapons applications. Continue the development of high power millimeter-wave source for airborne applications. Finish rebuild and manufacturer test of the second version of the conventional gyrotron approach. Begin build of the first coaxial design gyrotron. Continue with hardware development, procurement, fabrication, and testing for the full power source test stand. 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 2009: Continue to develop and evaluate technologies for non-lethal weapons applications. Downselect from conventional or coaxial approaches arriving at best high power millimeter-wave source hardware. Complete the development of millimeter-wave source for airborne applications in ground-based demonstration form. Complete hardware development, procurement, fabrication, and testing for the full power source test stand. Begin design and development of airborne antenna demonstration hardware to include beam control. 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)					
(U)	MAJOR THRUST: Develop the technology to integrate HPM devices on various platforms, to include	5.196	6.056	6.142	4.527

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

aerial, and investigate specific target sets of interest. Develop and demonstrate HPM technologies to disrupt, degrade, damage, or destroy an adversary's electronic systems.

(U) In FY 2006: Proceeded with maturation and miniaturization efforts of HPM subsystem technologies for both electronic attack and counter improvised explosive device applications. Conducted integration experiments that include investigating electromagnetic interference issues. Examined the interactions of the HPM source, antenna, and pulse power to increase functionality. Began integration efforts of all HPM subsystem components in preparation for stand-alone field demonstration. Refined HPM subsystems to ensure required energy levels are produced. Investigated optimal configuration for permanent magnets in relativistic magnetron, and fabricated source. Integrated the HPM subsystem with a command and control device to demonstrate operation at threshold operating parameters. Began defining hardening requirements of representative pallet against HPM subsystem predicted electromagnetic interference/coupling. Integrated a repetitively pulsed gigawatt-class HPM source and antenna that will be installed into an airborne platform. Conducted integration experiments that include investigating electromagnetic interference issues. Examined the interactions of the HPM source, antenna, and pulse power to increase functionality.

(U) In FY 2007: Continue miniaturization, integration and ruggedization of HPM testbed for field experimentation. Examine the interactions of the HPM source, antenna, and pulse power to increase functionality. Investigate enhanced configuration for permanent magnets in relativistic magnetron, and fabricate source. Begin fabrication of subcomponents as determined. Continue integration and begin HPM testbed testing and diagnostics on hardware for efficiency and to determine any potential electromagnetic interference/coupling issues. Improve HPM testbed command and control sub-systems. Demonstrate the performance of the integrated gigawatt-class HPM source and antenna. Investigate HPM system interaction with the airborne platform. Perform system diagnostics on integrated experiment to ensure proper source operation.

(U) In FY 2008: Integrate and ruggedize the HPM testbed for field experimentation. Perform HPM system testing and diagnostics on hardware developed and integrated in FY 2007 for efficiency and to determine any potential electromagnetic interference/coupling issues. Improve HPM testbed command and control systems for pulsed operation greater than threshold levels. Continue fabrication of subcomponents as determined by FY 2007 risk reduction exercise.

(U) In FY 2009: Conduct laboratory demonstration of the miniaturized and ruggedized HPM testbed. Begin fabrication of electromagnetic interference protection system. Implement the improved HPM

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603605F Advanced Weapons Technology**	PROJECT NUMBER AND TITLE **3152 High Power Microwave Technology**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	testbed command and control systems for pulsed operation greater than threshold levels. Implement subcomponents as determined by FY 2007 risk reduction exercise.				
(U)	Total Cost	10.170	12.890	10.504	9.153

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost

(U) Related Activities:
(U) PE 0602202F, Human Systems Technology.
(U) PE 0602605F, Directed Energy Technology.
(U) PE 0603851M, Nonlethal Weapons - Demonstration/Validation.
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy
Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3647 High Energy Laser Technology	8.488	3.915	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	0		

Note: Funds for the FY 2006 Congressionally-directed Aerospace Relay Mirror System in the amount of $2.100 million were transferred to PE 0603605F, Advanced Weapons Technology, from PE 0603500F, Multi-Disciplinary Advanced Development, for execution. Also in FY 2008, this effort moves into Project 3151 in this program element.

(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 2006	FY 2007	FY 2008	FY 2009
(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.	1.542	1.967	0.000	0.000
(U) In FY 2006: Identified overall device-level performance and issues based on the integration of the iodine generation and ejector nozzle concept into a laser device. Performed field demonstrations of closed-cycle chemical approaches for use on tactical airborne platforms. Used deuterated chemicals to improve device performance. Began work to extend the range of high power airborne chemical lasers. Tested deuterated fuels and determined performance increases. Performed basic hydrogen peroxide flowloop development and testing for tactical platforms. Tested and evaluated fuels regeneration system for reduced logistics tail for chemical oxygen iodine lasers.				
(U) In FY 2007: Test overall device-level performance and issues based on the integration of the ejector nozzle concepts and increased mass flow singlet-oxygen generators into a laser device. Test advanced fuels and determine performance increases. Investigate systems performance of airborne chemical oxygen iodine laser systems.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Aerospace Relay Mirror System	2.026	0.000	0.000	0.000
(U) In FY 2006: Developed preliminary designs for high energy laser redirection optical systems. Software				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	and optical hardware designs were matured to the point of critical design review. Completed thermal models of optical and mechanical components in high energy laser beam director systems and relay mirror payload element.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Laser Spark Countermeasure Program.	4.920	1.948	0.000	0.000
(U)	In FY 2006: Investigated Laser Spark missile infrared countermeasure technology and demonstrate the infrared countermeasures effectiveness of the multiple internal laser effects associated with plasma/sparks. Performed countermeasure effectiveness study for operational scenarios. Fabricated a brassboard countermeasure laser system. Performed demonstration testing. Modeled missile fly-out dynamics under countermeasure operation and determined effectiveness. Surveyed platform footprints available and perform packaging design.				
(U)	In FY 2007: Perform laboratory effects tests and modeling to resolve measured differences in the damage threshold of different focal plane arrays. Perform and document a countermeasure effectiveness study for selected operational scenarios.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	8.488	3.915	0.000	0.000

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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)	This project has been coordinated through the										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)**

Reliance 21 process to harmonize efforts and eliminate duplication.

(U) The technology efforts in this PE that are supporting future enhancements to airborne lasers have been coordinated with the Airborne Laser program office.

(U) **D. Acquisition Strategy**

Not Applicable.

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Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE
0603789F C3I Advanced Development

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	41.345	48.195	27.357	32.050	45.933	41.043	49.550	58.495	Continuing	TBD
4072	Dominant Battlespace Awareness	10.916	18.881	6.037	6.981	9.948	9.281	10.657	12.739	Continuing	TBD
4216	Battlespace Information Exchange	15.796	12.490	8.012	11.376	17.565	14.506	19.740	24.988	Continuing	TBD
4872	Aerospace Information Dominance	14.633	16.824	13.308	13.693	18.420	17.256	19.153	20.768	Continuing	TBD

(U) **A. Mission Description and Budget Item Justification**

This program develops and demonstrates Air Force 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, complex 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 reliable, secure, jam-resistant, inter-operable worldwide global information enterprise capabilities, providing the Air Force assured communications and reach-back capability in a distributed operational environment. It will also demonstrate offensive cyber operations technologies allowing attack and exploitation of adversary information systems by the Air Force. 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 in combat or peacekeeping missions. Note: In FY 2007, Congress added $1.0 million for Advanced Course in Engineering, $4.8 million for Advanced Fusion for Urban Operations for Forensic Anticipation of Insurgent Activity (Note: Only to expend the recently demonstrated Intelligence Fusion System to provide dynamic situational awareness of insurgent activities as precursors to critical events), $1.0M for Hybrid Radio Frequency/Optical Communications Terminal, $2.0 million for Massively Parallel Optical Interconnects for Battlespace Information Exchange, $1.0 million for National Center for Multi-Source Information Fusion Research, $1.0 million for Non-Traditional Intelligence Surveillance and Reconnaissance and $1.8 million for Semantic Service Orientated Architecture for Dynamic Intelligence Fusion Programs. 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.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603789F C3I Advanced Development**

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

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	41.124	37.785	31.161	38.298
(U)	Current PBR/President's Budget	41.345	48.195	27.357	32.050
(U)	Total Adjustments	0.221			
(U)	Congressional Program Reductions		-0.007		
	Congressional Rescissions	-0.033	-0.183		
	Congressional Increases		11.600		
	Reprogrammings	1.240	1.000		
	SBIR/STTR Transfer	-0.986			

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4072	Dominant Battlespace Awareness	10.916	18.881	6.037	6.981	9.948	9.281	10.657	12.739	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(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. DBA is the information required to support dynamic planning and execution with the accuracy, fidelity, and timeliness needed to dominate the battlespace. 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 n-dimensional representation of the battlespace; assessing the situation; predicting adversary courses of action (COA); and archiving the results for ready use by decision makers. This is a dynamic, complex 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 2006	FY 2007	FY 2008	FY 2009
(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.	1.615	2.732	1.988	2.152
(U) In FY 2006: Developed a baseline capability to perform advanced text exploitation of Human Intelligence (HUMINT) reports and correlate and fuse the information with information from other sources. Developed and assessed the ability to extract information from voluminous textual data.				
(U) In FY 2007: Demonstrate a baseline capability to perform advanced text exploitation of HUMINT reports and correlate and fuse the information with information from other sources. Demonstrate prototype that is able to extract information from voluminous textual data. Initiate development of a real-time Signal Processing and Geolocation capability for emerging commercial communications used by military and asymmetrical threats. Initiate development of airborne-cued, ground-based signal processing.				
(U) In FY 2008: Continue development of a real-time Signal Processing and Geolocation capability for emerging commercial communications used by military and asymmetrical threats. Continue development of airborne-cued, ground-based signal processing.				
(U) In FY 2009: Demonstrate a real-time Signal Processing and Geolocation capability for emerging commercial communications used by military and asymmetrical threats. Demonstrate airborne-cued ground-based signal processing				
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603789F C3I Advanced Development**	PROJECT NUMBER AND TITLE **4072 Dominant Battlespace Awareness**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(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. Note: This effort includes $1.0 million in FY 2006 Congressional Add funding, and $5.8M in FY 2007 Congressional Add funding.	4.964	9.808	4.049	4.829
(U)	In FY 2006: Developed a fusion evaluation environment, providing simulation and modeling capability, measures of performance, and operator-focused transition products to support the warfighter. Developed 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. Developed and demonstrated advanced fusion tools to enhance the capability for PBA. Used operator-focused techniques to evaluate the effectiveness of the fusion tools. Performed feature-aided tracking to monitor, assess, and predict possible courses of action. Developed initial reasoning algorithms and evidence accrual techniques for continuous knowledge development of the battlespace. Conducted 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 software and algorithmic development for determination of adversarial behavior within persistent surveillance data, contextual tracking, target-feature-aided tracking, multible intelligence sources (multi-INT) association and cross-cueing and geospatial reasoning and cued exploitation. Investigate methods for combining post-event processing of intelligence data with real-time streaming intelligence data for indications and warning functions. Conduct Congressionally-directed effort for Advanced Fusion in Urban Operations for Forensic Anticipation of Insurgent Activity. Conduct Congressionally-directed effort for National Center for Multi-Source Information.				
(U)	In FY 2008: Continue software and algorithmic design and development efforts for determination of adversarial behavior within persistent surveillance data, contextual tracking, target-feature-aided				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	tracking, multi-INT association and cross-cueing and geospatial reasoning and cued exploitation. Continue to develop methods for combining post-event processing of intelligence data with real-time streaming intelligence data for indications and warning functions. Initiate the design and development of a synthetic assessment environment for the evaluation of the full range of fusion technologies to include basic correlation algorithms to higher levels of fusion algorithms tested in conjunction with command and control systems. Initiate investigation of Fusion of Cyber Intelligence (CYBINT) with traditional INTs.				
(U)	In FY 2009: Demonstrate software and algorithmic design and development efforts for determination of adversarial behavior within persistent surveillance data, contextual tracking, target-feature-aided tracking, multi-INT association and cross-cueing and geospatial reasoning and cued exploitation. Demonstrate methods for combining post-event processing of Intel data with real time streaming Intel data for indications and warning functions. Continue design and development of a synthetic assessment environment for the evaluation of the full range of fusion technologies to include basic correlation algorithms to higher levels of fusion algorithms tested in conjunction with C2 systems. Continue investigation of Fusion of CYBINT with traditional INTs.				
(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: This effort contains $2.8 million in FY 2006 Congressional Add funding, and $1.0M in FY 2007 Congressional Add funding. In FY 2008, efforts in this thrust move to Project 4216 in this PE.	4.337	4.541	0.000	0.000
(U)	In FY 2006: Developed initial inter operable exploitation technologies for real-time ISR management. Enhanced ISR resource management development through incorporation of information sharing and network centric operations. Developed tools for mission/task-based priority and quality of service utilization of assets and fusion-focused ISR tasking, and explored the synergy between the two. Performed a multi-platform interoperability and limited tracking demonstration effort for integration of resource management, information management, and communications management capabilities. Conducted Congressionally-directed effort for Net-Centric Dissimilar Data Fusion Program.				
(U)	In FY 2007: Continue development of interoperable exploitation and data link 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				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	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. Conduct Congressionally-directed effort for Non-Traditional Intelligence, Surveillance, and Reconnaissance.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Semantic Service Oriented Architectures for Dynamic Intelligence Fusion	0.000	1.800	0.000	0.000
(U)	In FY 2006: Not Applicable				
(U)	In FY 2007: Develop and demonstrate a capability to collaboratively interact and manage sensor context sensitive knowledge across multiple platforms using Semantic Service Oriented Architectures, in conjunction with Intelligent Agent architectures, Ontological Knowledge, and Man-on-the-Look technology.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	10.916	18.881	6.037	6.981

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602702F, Command, Control, and Communications.										
(U) PE 0603203F, Advanced Aerospace Sensors.										
(U) PE 0603742F, Combat Identification Technology.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603789F C3I Advanced Development**	PROJECT NUMBER AND TITLE **4072 Dominant Battlespace Awareness**

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4216 Battlespace Information Exchange	15.796	12.490	8.012	11.376	17.565	14.506	19.740	24.988	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced communications technologies for the Air Force that implement a secure environment for worldwide information exchange of near-real-time multimedia (i.e., voice, data, video, and imagery) information. This secure environment will be rapidly deployable, mobile, interoperable, and seamless between Air and Space Operations Centers (AOC) and aircraft, either en route or in theater. It will: a) provide interoperability across echelons, Service, coalition 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, communications transmission systems, cyber situational awareness, and offensive cyber operations capabilities to attack and exploit adversary information and information systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop and demonstrate secure wideband assured networking between weapon platforms (e.g. munitions, uninhabited air systems, and aircraft), ground facilities and Special Operations Forces personnel.	3.273	3.876	0.954	1.134
(U) In FY 2006: Examined and developed or adapted networked communications to support Special Operations Forces ground elements by connecting them into the airborne network weapon platforms and reachback to globally located command centers.				
(U) In FY 2007: Continue to develop or adapt networked communications to support Special Operations Forces ground elements by connecting them into the airborne network weapon platforms and reachback to globally located command centers. Develop phase one of a small form-factor prototype information networking capability for information sharing and collaboration with other networking assets (aircraft, uninhabited air systems, ground facilities).				
(U) In FY 2008: Complete development of a small form-factor prototype information networking capability for information sharing and collaboration with other networking assets (aircraft, uninhabited air systems, ground facilities).				
(U) In FY 2009: Develop small form-factor networking and reachback capability. Begin certification of the capability in preparation for transition to the Special Operations Forces.				
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Proactively defend cyberspace through cyber situational awareness, detecting and defeating cyber threats, and surviving through adaptation and self-regeneration. Note: This effort transitions in FY 2008 from Applied Research PE 0602702F, Project 4519, into this PE.	0.000	0.000	0.782	2.886
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Develop technology demonstration plans for a fleet of cooperative agents trusted to defend mission critical Air Force assets by gathering cyber situational awareness information for defensive decision making. Develop secure data sharing to prevent the disclosure of sensitive information to untrustworthy users.				
(U)	In FY 2009: Develop technology demonstration plans for active ISR defense on wired networks. Continue cyber situational awareness demonstration. Continue development of secure data sharing to prevent the disclosure of sensitive information to untrustworthy users.				
(U)					
(U)	MAJOR THRUST: Design, develop, demonstrate, test, and validate an integrated tool suite for Modeling and Simulating the Air Force's extension of the Global Information Grid, the evolving Airborne Network. This thrust will provide the Air Force with the ability to accomplish both mission and technical analyses, at the appropriate levels of fidelity, to enable the effective migration of legacy systems for the development and evolution of the Airborne Network. Note: This efort transitions in FY 2008 from Applied Research PE 0602702F, Project 4519, into this PE.	0.000	0.000	0.670	1.374
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Test and validate the modeling and simulation capability using real world scenarios to determine the accuracy and real-time nature of the capability. Establish enhancements to the current modeling capability and to assess processing requirements.				
(U)	In FY 2009: Continue the validation of the enhanced modeling and simulation capability and support tool suite and make it usable by an operational person instead of programmers. Exercise the limitations of the modeling capability and apply the model to proposed future DoD networking environments.				
(U)					
(U)	MAJOR THRUST: Design, develop, and demonstrate the enterprise management capability to accept on-paper policy (e.g., word documents, or other Air Tasking Orders, etc.) and translate that format into network policy language to provide this "policy meta-data" to a network enterprise system in executable	0.000	0.000	0.784	1.019

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	form, in order to re-configure, re-constitute, and strengthen Air Force networks in response to strategic, tactical, and network events (e.g., changes in information condition (INFOCON), threat condition (THREATCON), defense condition (DEFCON), malicious threat, outages, etc.). Note: This effort transitions in FY 2008 from Applied Research PE 0602702F, Project 4519, into this PE.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Design and develop an enterprise management system with the capability to translate narrative policy into machine-readable code in order to reconfigure the network in response to strategic, tactical, and network threats.				
(U)	In FY 2009: Develop and demonstrate reconfiguration of network based-policy in response to strategic, tactical, and network events (e.g., changes in information condition (INFOCON), threat condition (THREATCON), defense condition (DEFCON), malicious threat, outages, etc.).				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate offensive cyber operations capabilities in a series of experimental cyber craft technology demonstrations. These demonstrations will integrate capabilities developed from ongoing offensive cyber programs in the areas of gaining access to systems, performing operations in a stealthy manner, gathering intelligence from the compromised systems, and launching cyber "effects" against the systems. Note: This effort transitions in FY 2008 from Applied Research PE 0602702F, Project 4519, into this PE.	0.000	0.000	1.393	2.680
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Initiate development of offensive cyber capabilities to access, remain stealthy, gather intelligence, and affect adversary information and information systems. Develop technology demonstration plans for cyber operations.				
(U)	In FY 2009: Continue development and demonstrate selected offensive cyber operations capabilities. Demonstrate and integrated kinetic and cyber operations planning and execution capability. Develop cyber command and control (Cyber C2) operations functions.				
(U)					
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced expert system decision algorithms to prioritize and control resources for global reach. This effort contains $2.8 million in FY 2006 Congressional Add funding.	3.456	0.540	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603789F C3I Advanced Development**	PROJECT NUMBER AND TITLE **4216 Battlespace Information Exchange**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2006: Transitioned the combined Intelligent Information Manager, Integrated Network Controller, and the Global Media Access Controller to jump start Network Centric communications. Conducted 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.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate intelligent networking transport and management technology to provide assured, seamless, battlespace connectivity to the Air Force with a greatly reduced footprint. Note: This effort includes $3.9 million in FY 2006 and $2.0 million in FY 2007 Congressional Add funding.	7.139	6.080	3.429	2.283
(U)	In FY 2006: Developed mechanisms to enable integrated management of communications and sensor resources. Assessed communications needed to support ground moving target tracking, multi-intelligence exploitation and fusion, and sensor resource management systems and techniques. Established a framework for integration and development of a common-coordinated management function for command, control, intelligence, surveillance, and reconnaissance networking. Developed 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. Investigated the complexities of multi-intelligence exploitation and incorporated enhancements into the development. Continued to develop and demonstrate an efficient on-board optical interconnectivity solution that addresses all intra and inter-platform communications, including telemetry/command/control, and payload related data exchange needs of unmanned airborne vehicles and micro satellite platforms.				
(U)	In FY 2007: Demonstrate improved battle management command, control, and communications networked collaboration capabilities by making improvements in routing, mobile ad-hoc networks, and adaptive protocols to show the effectiveness for ISR platforms. Develop and demonstrate a survivable, mobile, deployable extension of the global information enterprise to support rapid, decisive and sustainable air power, command and control weapons data links, and ISR assets. Conduct Congressionally-directed effort for Massively Parallel Optical Interconnects to Battlespace Information				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE 4216 Battlespace Information Exchange

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	Exchange.				
(U)	In FY 2008: Continue improvements in the battle management command, control and communications networked collaborative capability by demonstrating Air Force airborne networking, in a coalition and multi-service environment, enabling aircraft to access each other's ISR airborne and ground information environments. Initiate the development of advanced, automated, network and bandwidth management technologies to move, manage, and process information in real-time to provide dynamic Quality of Assurance/Quality of Service for the warfighter. Initiate investigation to provide assured access (anti-jam) covert high capacity spectrum dominance for global networking, while denying the adversary the same.				
(U)	In FY 2009: Complete improvements in the battle management command, control, and communications networked collaborative capability by demonstrating Air Force airborne networking, in a coalition and multi-service environment, enabling aircraft to access each other's intelligence, surveillance, and reconnaissance (ISR) airborne and ground information environments. Continue the development of advanced, automated, network and bandwidth management technologies to move, manage, and process information in real-time to provide dynamic Quality of Assurance/Quality of Service for the warfighter. Continue investigation to provide assured access (anti-jam) covert high capacity spectrum dominance for global networking, while denying the adversary the same.				
(U)					
(U)	CONGRESSIONAL ADD: Griffith Institute - Accelerated Course in Engineering.	0.964	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Griffith Institute - Accelerated Course in Engineering.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Hybrid Radio Frequency - Optical Communications Terminal.	0.964	0.994	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Hybrid Radio Frequency - Optical Communications Terminal. Developed parts and subsystems that can be used in either optical or RF communications systems, and be used simultaneously for RF and optical communications.				
(U)	(U) In FY 2007: Continue Congressionally directed effort for Hybrid Radio Frequency - Optical Communications Terminal. Continue development of parts and subsystems that can be used in either				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	optical or RF communications systems, and be used simultaneously for RF and optical communications. Integrate RF and Optical hardware into a common subsystem. Develop the signaling protocols combining optical and RF characteristics. Develop packaging concepts for the combined RF and optical techniques.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Cyber Security - Advanced Course in Engineering	0.000	1.000	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop 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 FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	Total Cost	15.796	12.490	8.012	11.376

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4872	Aerospace Information Dominance	14.633	16.824	13.308	13.693	18.420	17.256	19.153	20.768	Continuing	TBD
	Quantity of RDT&E Articles	0	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, the Air Force must be able to plan, assess, monitor, and replan missions rapidly across the full spectrum of operations (air, space and cyberspace) at all levels of war (strategic, operational, and tactical) and during all phases of conflict (pre-conflict, conflict and stability operations). This project develops and demonstrates technologies necessary for dynamic decision making. It provides the technology and demonstrations needed to enable the warfighter to monitor, assess, plan, and execute (MAPE) on the complex and compressed time scales required for tomorrow's conflicts, whether they are combat or operations other than war. It will develop and demonstrate a new generation of planning and assessment technologies that enable a new paradigm of network enabled operations, allowing decision makers to determine the desired operational effects and prosecute the mission accordingly. This project will develop innovative capabilities that will realize a strategy-to-task approach to warfare, exploiting anticipatory environments and agile command and control concepts. It will develop and demonstrate distributed information technologies that provide the decision maker and staff with seamless access to tailored multi-media, multi-spectral data, within a mobile, dynamic, scalable, globally distributed Air and Space Operations Center (AOC). This project will also develop knowledge-based intelligent information technologies to support robust, real-time, large-scale Air Force command and control systems.

(U)	**B. Accomplishments/Planned Program ($ in Millions)**	FY 2006	FY 2007	FY 2008	FY 2009
(U)	(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 decision makers and staff in mobile, dynamic, scalable, globally distributed command and control centers.	3.928	5.479	4.169	2.143
(U)	In FY 2006: Investigated a core set of functionality and supporting infrastructure for next generation operation centers, enabling the ability to plan, direct, coordinate, and control air forces and operations across security boundaries in a coalition environment. Developed joint Service collaborative planning of mission packages with tailorable and exportable information reports/briefings associated with air space management and deconfliction. Continued developing highly efficient business processes and tools to support information exchange between operations centers and other command and control centers. Explored the integration of intelligent agents that use physics-based modeling to provide accurate, detailed advice necessary to make informed decisions. Applied appropriate system of systems and federation of systems engineering principles to create joint command and control decision-support capabilities.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

(U) In FY 2007: Continue to investigate a core set of functionality and supporting infrastructure, including multi-level security repositories for next generation operation centers, enabling the ability to plan, direct, coordinate, and control air forces and operations across security boundaries in a coalition environment. Develop execution of the air space plan and re-planning options to enable dynamic deconfliction capabilities; avoiding hazardous conditions. Demonstrate highly efficient business processes and tools to support information exchange between operations centers and other command and control centers. Prototype and demonstrate intelligent agents that use physics-based modeling to provide accurate, detailed advice necessary to make informed decisions. Develop command and control decision-support capabilities. Initiate investigation of the processes and procedures to normalize the use of information operations with precision munitions to achieve desired effects against our adversaries within the air, space and cyberspace domains. Develop peer-to-peer and publish/subscribe information distribution systems and adaptive embedded computing techniques operating within a persistent surveillance system for very high resolution, wide-area, and global positioning system-coded surveillance images. Initiate development of polymorphic computing technology for persistent surveillance systems using faster processing and greatly reduced size, weight, and power.

(U) (U) In FY 2008: Complete development of capabilities that allow a networked enabled operations center to plan, direct, coordinate air force assets across security boundaries in a coalition environment. Develop and demonstrate the capability to accomplish dynamic air space management and de-confliction of manned and unmanned aircraft focused on air control measure parsing, timely conflict identification, advanced visualization and seamless collaboration. Develop a campaign of experimentation to quantitatively measure transformational command and control concepts enabled by net centric warfare capabilities. Demonstrate command and control decision-support capabilities. Continue to develop the capability to normalize the use of information operations with precision munitions to achieve desired effects against our adversaries within the air, space and cyberspace domains. Complete development of peer-to-peer and publish/subscribe/query information distribution systems and adaptive embedded computing techniques operating within a persistent surveillance system for very high resolution, wide-area, and global positioning system-coded surveillance images. Continue the development of polymorphic (adaptable) computing technology for persistent surveillance systems using faster processing and greatly reduced size, weight, and power requirements for processing hardware. Continue the development and application of Multi-Level Security/Multiple Single Levels of Security (MLS/MSLS) middleware technologies for persistent surveillance systems to support user access/denial

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	of information at multiple security levels.				
(U)	(U) In FY 2009: Initiate the development of capabilities to allow seamless information sharing for enhanced situational awareness and understanding by the decision maker. Continue the development of an initial capability to plan and measure effectiveness of information operations in conjunction with precision munitions to determine successful achievement of command intent in time and location to achieve "self-synchronization." Continue campaign of experimentation to quantitatively measure transformational command and control concepts enabled by net centric warfare capabilities. Complete the development of polymorphic (adaptable) computing technology for persistent surveillance systems using faster processing and greatly reduced size, weight, and power requirements for processing hardware. Continue the development and application of Multi-Level Security/Multiple Single Levels of Security (MLS/MSLS) middleware technologies for persistent surveillance systems to support user access/denial of information at multiple security levels.				
(U)					
(U)	(U) MAJOR THRUST: Develop and demonstrate the integration of planning tools and information-based intelligent agents for adaptive preplanning and decision support tools for Air Force command and control systems	2.282	3.983	1.245	0.694
(U)	In FY 2006: Developed 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. Developed advanced reasoning techniques for mobility courses-of-action development. Applied the use of advanced computer mark-up languages and developed a common mobility ontology to improve automation of decision support tools for increased situational awareness, planning, and execution management. Investigated 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. Developed improved synchronization among Global Strike and Global Mobility Force participants within multiple theaters and global Civil ATM. Developed the capability to support collaborative command and control, including dynamic and intermittent participation of players. Developed automated machine-to-machine exchange of selected information between CAF aircraft, MAF aircraft, their respective command and control elements, and civil ATM agencies. Explored the feasibility of virtual staff members to maintain a vision of command and control processes during human absences providing a 24/7 coverage.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **03 Advanced Technology Development (ATD)**	PE NUMBER AND TITLE **0603789F C3I Advanced Development**	PROJECT NUMBER AND TITLE **4872 Aerospace Information Dominance**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
(U)	In FY 2007: Demonstrate 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. Demonstrate advanced reasoning techniques for mobility courses-of-action development. Demonstrate the use of common mobility ontology to improve automation of decision support tools for increased situational awareness, planning, and execution management. Develop technologies to enable a CAF, MAF, civilian shared situational awareness/synchronization to achieve desired "effects" and ensure mission success in a global environment. Demonstrate improved synchronization among Global Strike and Global Mobility Force participants within multiple theaters and global Civil ATM. Demonstrate the capability to support collaborative command and control, including dynamic and intermittent participation of players. Develop additional automated machine-to-machine exchange capabilities between CAF aircraft, MAF aircraft, their respective command and control 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 command and control processes during human absences providing a 24/7 coverage.				
(U)	In FY 2008: Complete development of improved synchronization among Global Strike and Global Mobility Force participants within multiple theaters and global Civil air traffic management (ATM). Complete automated machine-to-machine exchange of selected information capabilities between CAF aircraft, MAF aircraft, and their respective command and control elements. Complete multi-mission optimization capability by exploiting information discovery and delivery, advanced, multi-constraint and distributed optimization techniques, and evaluation models to support mobility operations with special emphasis on increased efficiency and decreased routine workload across functional and supervisory positions. Demonstrate capability for cross-functional collaboration that will increase situation awareness and understanding during mission planning and execution to allow the planning and execution teams to self-synchronize, ensuring a highly coordinated effort. Complete development of next generation tools and technologies to revolutionize air mobility information dominance to respond swiftly to global demands across all spectrums of operations from humanitarian relief to a major conflict.				
(U)	In FY 2009: Initiate development of capabilities to be more agile within a net centric enabled environment. Develop timely option generation selection and coordination capabilities that account for uncertainty and missing and erroneous information, and supports intuitive decision making process between man and machine collaborating on complex, dynamic problems exploiting the respective				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	strengths of machines (process lots of data) and human (analytical reasoning). Develop dynamic workflow and workload management capabilities to manage the command and control constellation of resources.				
(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 2006, this effort completed.	0.804	0.000	0.000	0.000
(U)	In FY 2006: Developed and demonstrated a Time Sensitive Target automated decision-aiding capability for an Advanced Technology Aerospace Operations Center type of facility in a spiral fashion.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate an effects-based approach for the next generation of planning and assessment techniques that enable decision makers to determine the desired operational effects (nth-order) at the right place at the right time, anywhere, anytime.	3.711	4.468	3.600	4.481
(U)	In FY 2006: Developed 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. Developed capabilities to support air operations center personnel in developing and assessing, in near-real-time, various course of action options based upon commander's intent, predictive battlespace awareness tools, and the ability to reason over models of the "enemy as a system." Developed technologies to capture, assess, and integrate cause-and-effect (first, second, and third order) relationships endemic to this "enemy as a system." Investigated advanced information technologies to shorten the current execution timelines, while also allowing significant reductions in the number of personnel required in operation centers. Developed warfighter-accepted operational concepts and architecture views for a Streaming Air Tasking Order (ATO) generator and dynamic effects-based assessment capability. Developed initial spiral developments of concept demonstrations of a Streaming ATO generation capability. This will enable more responsive and continuous planning, execution, and assessment within the operations center.				
(U)	In FY 2007: Develop improved technologies to support effects-based planning, execution, and assessment by enabling the generation, tasking, and assessment of effects-based dynamic air execution				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006 FY 2007 FY 2008 FY 2009

orders. Develop improvements to support operations center personnel in assessing course of action options, based upon commander's intent, predictive battlespace awareness tools, and the ability to reason over models of the "enemy as a system." Develop technologies to capture, assess, and integrate cause-and-effect (first, second, and third order) relationships endemic to this "enemy as a system." Develop advanced information technologies to shorten the current execution timelines, while also allowing significant reductions in the number of personnel required in an operations center. 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) In FY 2008: Demonstrate concepts and technologies supporting effects-based planning, execution, and assessment by enabling the generation, tasking, and assessment of effects-based tasking. Demonstrate technologies to allow operations center personnel to assess, in near-real-time, various courses of action (COA) options based upon command intent. Develop technologies to capture and assess integrated cause-and-effect (first, second, and third order) relationships endemic to this "enemy as a system." Complete the operational concept and architecture for effects based assessment to drive software development and experimentation to determine the ability of developed capabilities to assist warfighters in conducting accurate and timely assessments. Complete the development of techniques to continually assess status of planned actions against adversary systems to determine whether predicted effects are actually achieved. Initiate an analysis of cascading effects in real-time for diverse courses of action. Initiate research to forecast actionable futures to support a decision maker's ability to appraise and plan the "best" blue course of action for Rapid, Decide, Act and Adapt (RDAA). Initiate investigation of ability to forecast potential adversaries and events based on indications of known evidence and projected known and/or anticipated threat(s).

(U) In FY 2009: Demonstrate technology to meet the needs for effects-based assessment in an operational environment. Design, develop and demonstrate the capabilities for continuous effects based assessment in a dynamic tasking environment. Demonstrate techniques to accomplish up-to-date awareness on whether the execution of the battle plan is meeting the desired effects. Investigate the methods to enable a decision support environment that enables the decision maker to anticipate and shape all aspects of the future battlespace. Initiate development of predictive battlespace awareness tools with the ability to reason over models of the "enemy as a system." Continue analysis of cascading effects in real-time for diverse courses of action. Continue research to forecast actionable futures to support a decision maker's

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
	ability to appraise and plan the "best" blue course of action for Rapid, Decide, Act and Adapt (RDAA). Continue investigation of ability to forecast potential adversaries and events based on indications of known evidence and projected known and/or anticipated threat(s). Initiate assured end-to-end Quality of Service (QoS) and Quality of Assurance (QoA) integration to the information system enterprise during malicious and non-malicious faults.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate high performance computing for size, weight, and power-limited applications, and emulate older computing components. Note: This effort transitions in FY 2008 from Applied Research PE 0602702F, Project 4594, into this PE.	0.000	0.000	1.354	0.693
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Develop high performance computing for size, weight, and power-limited applications. Transition power efficient processors to DoD users by addressing power, programmability, and radiation issues. Develop and demonstrate emulation of older computing components and boards, allowing re-use of existing software while gaining the advantages of modern semiconductor processing technology.				
(U)	In FY 2009: Complete development of high performance computing for size, weight, and power-limited applications. Support the resulting hardware and software transition to the users. Initiate development of reliably autonomic small platforms for unmanned operations. Initiate development of tools, techniques, standards, and technologies to build highly complex software-intensive systems.				
(U)					
(U)	(U) MAJOR THRUST/CONGRESSIONAL ADD: Demonstrate how a publish, subscribe, and query information management paradigm can enable vertical and horizontal integration of Air Force command, control, communication, computers, intelligence, surveillance, and reconnaissance information systems. Develop 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 operations infrastructure. Note: This effort includes $1.3 million in FY 2006 Congressional Add funding.	3.908	2.894	2.940	5.682
(U)	In FY 2006: Developed initial next generation COI infosphere prototypes to provide real-time performance, security to Air Force standards, and high levels of scalability to meet Air Force net-centric operational needs. Supported information engineering efforts allowing various existing and new Air				

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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 2006 FY 2007 FY 2008 FY 2009

Force systems to utilize COI infosphere prototypes. Conducted Congressionally-directed efforts for secure Battlespace Information Exchange.

(U) In FY 2007: Ramp down information engineering efforts that allow existing and new Air Force systems to utilize COI infosphere prototypes. Develop next generation COI infospheres to provide real-time performance, security to Air Force standards, and high levels of scalability. Initiate study of tactical information management to enable information exchange across the enterprise to the tactical edge. Initiate the development of information management infrastructure to federate information among COI infospheres and across distinct information based communities.

(U) In FY 2008: Develop tactical and federated COI infospheres to manage information objects from diverse sources and data environments within and across the tactical edge. Apply adaptor technology to allow existing Air Force systems to rapidly integrate with and utilize COI information sources, with a special emphasis on distributed and decentralized information brokering technology to enhance systems integration of information sources across the global information enterprise adapting to infrastructure and topology constraints. Complete information engineering efforts focusing on Unit Command and Control (Unit C2) and the Installation Control Center (ICC) goals of providing unit decision makers with an integrated, standardized enterprise capability to control and manage resources to execute assigned missions; providing the ability to collaborate and synchronize Unit enterprise activities with the Warfighting Headquarters; and sharing information real time in the accomplishment of normal day-to-day operations or in generating aircraft to support the wartime Air Tasking Order (ATO). Initiate the development of technologies that enable a generic methodology for the dissemination of information across multiple security level boundaries. Develop capability integrating tactical and edge user information management requirements. Initiate development of information transformation services and adaptive information management services that learn, self-configure, self-manage, and are self-healing. Initiate a study on collaboration services on demand that will exploit dynamic information services matching end user devices (laptops, cell phones, etc.) with appropriate information formats. Continue to support development of COI Infospheres in the areas of context aware collaborative user interfaces and semantic interoperability.

(U) In FY 2009: Develop and demonstrate technologies that enable pub/sub/query information dissemination across multiple security level boundaries. Initiate the study of discovery and filter technology to assess, evaluate and convert unstructured information into structured information feeds. Demonstrate capability integrating tactical and edge user information management requirements.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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 2006	FY 2007	FY 2008	FY 2009
(U)	Continue development of information transformation services and adaptive information management services that learn, self-configure, self-manage, and are self-healing. Continue study on collaboration services on demand that will exploit dynamic information services matching end user devices (laptops, cell phones, etc.) with appropriate information formats. Continue to support context aware collaborative user interfaces and semantic interoperability.				
(U)					
(U)	Total Cost	14.633	16.824	13.308	13.693

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification

DATE
February 2007

BUDGET ACTIVITY
03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE
0603924F High Energy Laser Advanced Technology Program

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	5.559	3.699	3.815	4.152	4.255	4.322	4.407	4.499	Continuing	TBD
5095	High Energy Laser Advanced Technology Program	5.559	3.699	3.815	4.152	4.255	4.322	4.407	4.499	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. 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. Technology addressed in this area includes the HEL JTO Electric Laser initiative. 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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	5.713	3.713	3.781	4.106
(U)	Current PBR/President's Budget	5.559	3.699	3.815	4.152
(U)	Total Adjustments	-0.154			
(U)	Congressional Program Reductions				
	Congressional Rescissions		-0.014		
	Congressional Increases				
	Reprogrammings				
	SBIR/STTR Transfer	-0.154			

(U) Significant Program Changes:
Not Applicable.

C. Performance Metrics
Under Development.

Exhibit R-2a, RDT&E Project Justification	DATE February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
03 Advanced Technology Development (ATD)	**0603924F High Energy Laser Advanced Technology Program**	**5095 High Energy Laser Advanced Technology Program**

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5095	High Energy Laser Advanced Technology Program	5.559	3.699	3.815	4.152	4.255	4.322	4.407	4.499	Continuing	TBD
	Quantity of RDT&E Articles	0	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. 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. Technology addressed in this area includes the HEL JTO Electric Laser initiative. 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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Advance solid state laser development, to include advanced technology demonstrations up to a Technology Readiness Level 6. Develop free electron laser technologies that scale to high power. Develop beam-control technologies for surface and air mission areas.	5.559	3.699	3.815	4.152

(U) In FY 2006: Began the phase III of the Joint High Power Solid State Laser (JHPSSL) project with the Air Force, Army, and Navy, to demonstrate 100 kilowatt laboratory laser devices. Conducted necessary studies to understand and improve fieldability of solid state lasers. Developed technologies leading to a 100 kilowatt class free electron laser demonstration.

(U) In FY 2007: Continue the development of the 100 kilowatt JHPSSL development. Determine the requirements for other high-value experiments to follow the 100 kilowatt project, and begin planning as appropriate. Investigate advanced beam control architectures and algorithms. Develop technologies leading to a 100 kilowatt class free electron laser (FEL) demonstration.

(U) In FY 2008: Continue the development of the 100 kilowatt JHPSSL project. Provide for independent government-sponsored measurements of the 100 kilowatt laser(s). Initiate systems level studies for integration onto airborne platforms. Initiate joint high-power beam director development effort, suitable for mating with the JHPSSL phase III laser device. Participate in the Advanced Tactical Laser extended user evaluation.

(U) In FY 2009: Demonstrate 100 kilowatt solid state laser in laboratory environment. Continue beam director development effort and integrate the joint high-power beam director and 100 kilowatt JHPSSL

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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**

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	**B. Accomplishments/Planned Program ($ in Millions)**				
	laser, in preparation for a weapon system demonstration. Participate in the Advanced Tactical Laser extended user evaluation.				
(U)	Total Cost	5.559	3.699	3.815	4.152

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

		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 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 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										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
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)**

coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) **D. Acquisition Strategy**

Not Applicable.