DEPARTMENT OF THE AIR FORCE

FISCAL YEAR (FY) 2010 BUDGET ESTIMATES

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

DESCRIPTIVE SUMMARIES, VOLUME I

BUDGET ACTIVITIES 1 - 3

MAY 2009

Fiscal Year 2010 Program And Budget Estimates
RDT&E Descriptive Summaries, Volume I
Scientific and Technology Budget Activities 1 - 3
May 2009

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 2010 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 2010 RDT&E program with the exception of classified program elements. The formats and contents of this document are in accordance with the guidelines and requirements of the Congressional committees insofar as possible.
         b) The "Other Program Funding Summary" portion of the R-2 includes, in addition to RDT&E funds, Procurement funds and quantities, Military Construction appropriation funds on specific development programs, Operations and Maintenance appropriation funds where they are essential to the development effort described, and where appropriate, Department of Energy (DOE) costs.
         c) "Facilities Exhibits", Military Construction Project Data, (DD 1391), for improvements to and construction of government-owned facilities funded in RD&E are included 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.

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Department of the Air Force
FY 2010/2011 President's Budget
Exhibit R-1
Summary
(Dollars in Thousands)

05 MAY 2009

Summary Recap of Budget Activities	FY 2008	FY 2009	FY 2010
Basic Research	403,995	464,290	466,111
Applied Research	1,148,114	1,213,683	1,094,651
Advanced Technology Development	666,736	722,524	618,030
Advanced Component Development & Prototypes	2,620,511	2,530,283	1,795,884
System Development & Demonstration	4,138,350	4,159,289	4,219,726
RDT&E Management Support	1,485,564	1,127,767	1,046,524
Operational Systems Development	15,883,545	16,834,385	18,751,901
Total Research, Development, Test & Eval, AF	26,346,815	27,052,221	27,992,827

Summary Recap of FYDP Programs			
Strategic Forces	110,411	85,539	735,769
General Purpose Forces	2,376,981	2,352,545	2,331,745
Intelligence and Communications	2,225,360	2,492,422	3,262,011
Mobility Forces	763,908	668,563	628,244
Research and Development	9,774,486	9,483,102	8,714,607
Central Supply and Maintenance	216,874	258,385	273,226
Training Medical and Other	6,039	4,318	7,360
Administration and Associated Activities	76,787	52,173	81,033
Support of Other Nations	3,903	3,899	3,748
Classified Programs	10,792,066	11,651,275	11,955,084
Total Research, Development, Test & Eval, AF	26,346,815	27,052,221	27,992,827

Exhibit R-1: Total (Direct and Supplementals), as of May 5, 2009 at 12:28:14

Department of the Air Force
FY 2010/2011 President's Budget
Exhibit R-1
(Dollars in Thousands)

APPROPRIATION: 3600F Research, Development, Test & Eval, AF — Date: 05 MAY 2009

Line No	Program Element Number	Item	Act	FY 2008	FY 2009	FY 2010	SEC
1	0601102F	Defense Research Sciences	01	275,207	313,845	321,028	U
2	0601103F	University Research Initiatives	01	116,567	137,056	132,249	U
3	0601108F	High Energy Laser Research Initiatives	01	12,221	13,389	12,834	U
	Basic Research			403,995	464,290	466,111	
6	0602015F	Medical Development	02	1,490	4,887		U
7	0602102F	Materials	02	175,040	188,152	127,957	U
8	0602201F	Aerospace Vehicle Technologies	02	135,401	123,036	127,129	U
9	0602202F	Human Effectiveness Applied Research	02	90,603	93,222	85,122	U
10	0602203F	Aerospace Propulsion	02	217,266	252,024	196,529	U
11	0602204F	Aerospace Sensors	02	118,740	128,447	121,768	U
12	0602601F	Space Technology	02	124,910	138,980	104,148	U
13	0602602F	Conventional Munitions	02	61,469	57,407	58,289	U
14	0602605F	Directed Energy Technology	02	55,062	62,701	105,677	U
15	0602702F	Command Control and Communications	02	119,545	115,559		U
16	0602788F	Dominant Information Sciences and Methods	02			115,278	U
17	0602890F	High Energy Laser Research	02	48,588	49,268	52,754	U
	Applied Research			1,148,114	1,213,683	1,094,651	
18	0603112F	Advanced Materials for Weapon Systems	03	61,166	62,676	37,901	U
19	0603199F	Sustainment Science and Technology (S&T)	03			2,955	U

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20	0603203F	Advanced Aerospace Sensors	03	60,877	65,115	51,482	U
21	0603211F	Aerospace Technology Dev/Demo	03	70,352	45,990	76,844	U
22	0603216F	Aerospace Propulsion and Power Technology	03	139,591	180,554	175,676	U
23	0603231F	Crew Systems and Personnel Protection Technology	03	36,084	36,411		U
24	0603270F	Electronic Combat Technology	03	26,947	30,241	31,021	U
25	0603401F	Advanced Spacecraft Technology	03	97,639	97,469	83,909	U
26	0603444F	Maui Space Surveillance System (MSSS)	03	41,357	36,339	5,813	U
27	0603456F	Human Effectiveness Advanced Technology Development	03			24,565	U
28	0603601F	Conventional Weapons Technology	03	18,698	17,166	14,356	U
29	0603605F	Advanced Weapons Technology	03	78,556	56,283	30,056	U
30	0603680F	Manufacturing Technology Program	03		56,376	39,913	U
31	0603788F	Battlespace Knowledge Development and Demonstration	03			39,708	U
32	0603789F	C3I Advanced Development	03	31,781	33,902		U
33	0603924F	High Energy Laser Advanced Technology Program	03	3,688	4,002	3,831	U
		Advanced Technology Development		666,736	722,524	618,030	
34	0603260F	Intelligence Advanced Development	04	5,892	6,570	5,009	U
35	0603287F	Physical Security Equipment	04	2,767	1,672	3,623	U
36	0603421F	NAVSTAR Global Positioning System III	04	446,197			U

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Line No	Program Element Number	Item	Act	FY 2008	FY 2009	FY 2010	SEC
37	0603423F	Global Positioning System III - Operational Control Segment	04		306,502		U
38	0603430F	Advanced EHF MILSATCOM (SPACE)	04	612,318	386,425	464,335	U
39	0603432F	Polar MILSATCOM (SPACE)	04	171,775	236,965	253,150	U
40	0603438F	Space Control Technology	04	61,659	86,110	97,701	U
41	0603742F	Combat Identification Technology	04	25,170	29,300	27,252	U
42	0603790F	NATO Research and Development	04	4,173	4,322	4,351	U
43	0603791F	International Space Cooperative R&D	04	593	620	632	U
44	0603845F	Transformational SATCOM (TSAT)	04	776,505	761,285		U
45	0603850F	Integrated Broadcast Service	04	20,873	21,020	20,739	U
46	0603851F	Intercontinental Ballistic Missile	04	26,069	70,237	66,079	U
47	0603854F	Wideband Global SATCOM RDT&E (Space)	04	20,992	52,080	70,956	U
48	0603859F	Pollution Prevention	04	10,660	11,645	2,896	U
49	0603860F	Joint Precision Approach and Landing Systems	04	6,216	7,358	23,174	U
50	0604015F	Next Generation Bomber	04	7,000			U
51	0604283F	Battle Mgmt Com & Ctrl Sensor Development	04			22,612	U
52	0604327F	Hard and Deeply Buried Target Defeat System (HDBTDS) Program	04			20,891	U
53	0604330F	Joint Dual Role Air Dominance Missile	04			6,882	U
54	0604337F	Requirements Analysis and Maturation	04			35,533	U

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Line No	Program Element Number	Item	Act	FY 2008	FY 2009	FY 2010	SEC
55	0604635F	Ground Attack Weapons Fuze Development	04			18,778	U
56	0604796F	Alternative Fuels	04		54,217	89,020	U
57	0604830F	Automated Air-to-Air Refueling	04		9,862	43,158	U
58	0604856F	Common Aero Vehicle (CAV)	04	3,695			U
59	0604857F	Operationally Responsive Space	04	86,985	196,561	112,861	U
60	0604858F	Tech Transition Program	04			9,611	U
61	0305178F	National Polar-Orbiting Operational Environmental Satellite System (NPOESS)	04	330,972	287,532	396,641	U
		Advanced Component Development & Prototypes		2,620,511	2,530,283	1,795,884	
62	0603840F	Global Broadcast Service (GBS)	05	21,373	18,709	31,124	U
63	0604222F	Nuclear Weapons Support	05	19,739	20,111	37,860	U
64	0604226F	B-1B	05	180,434	142,643		U
65	0604233F	Specialized Undergraduate Flight Training	05	14,033	13,426	6,227	U
66	0604240F	B-2 Advanced Technology Bomber	05	277,880	364,076		U
67	0604261F	Personnel Recovery Systems	05	60,344			U
68	0604270F	Electronic Warfare Development	05	76,169	56,342	97,275	U
69	0604281F	Tactical Data Networks Enterprise	05			88,444	U
70	0604287F	Physical Security Equipment	05	33	52	50	U
71	0604329F	Small Diameter Bomb (SDB)	05	147,586	126,324	153,815	U
72	0604421F	Counterspace Systems	05	59,379	76,147	64,248	U
73	0604425F	Space Situation Awareness Systems	05	206,362	209,266	308,134	U

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Line No	Program Element Number	Item	Act	FY 2008	FY 2009	FY 2010	SEC
74	0604429F	Airborne Electronic Attack	05	23,170	43,123	11,107	U
75	0604441F	Space Based Infrared System (SBIRS) High EMD	05	583,305	542,411	512,642	U
76	0604443F	Third Generation Infrared Surveillance (3GIRS)	05	75,410	953	143,169	U
77	0604602F	Armament/Ordnance Development	05	7,558	2,089	18,671	U
78	0604604F	Submunitions	05	1,970	1,725	1,784	U
79	0604617F	Agile Combat Support	05	11,856	5,775	11,261	U
80	0604706F	Life Support Systems	05	13,247	16,553	10,711	U
81	0604735F	Combat Training Ranges	05	15,541	27,971	29,718	U
82	0604740F	Integrated Command & Control Applications (IC2A)	05	27,804	9,704	10	U
83	0604750F	Intelligence Equipment	05	5,037	2,282	1,495	U
84	0604800F	Joint Strike Fighter (JSF)	05	1,939,107	1,734,299	1,858,055	U
85	0604851F	Intercontinental Ballistic Missile	05			60,010	U
86	0604853F	Evolved Expendable Launch Vehicle Program (SPACE)	05	6,500	33,628	26,545	U
87	0605011F	RDT&E for Aging Aircraft	05	26,973	13,791		U
88	0605221F	Next Generation Aerial Refueling Aircraft	05		22,938	439,615	U
89	0605277F	CSAR-X RDT&E	05		232,232	89,975	U
90	0605278F	HC/MC-130 Recap RDT&E	05		11,660	20,582	U
91	0605452F	Joint SIAP Executive Program Office	05			34,877	U
92	0207434F	Link-16 Support and Sustainment	05	186,371	192,460		U

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Line No	Program Element Number	Item	Act	FY 2008	FY 2009	FY 2010	SEC
93	0207450F	E-10 Squadrons	05	37,675			U
94	0207451F	Single Integrated Air Picture (SIAP)	05	4,723	66,663	13,466	U
95	0207701F	Full Combat Mission Training	05	60,171	134,786	99,807	U
96	0305176F	Combat Survivor Evader Locator	05	4,900			U
97	0401138F	Joint Cargo Aircraft (JCA)	05	20,283	16,732	9,353	U
98	0401318F	CV-22	05	23,417	18,512	19,640	U
99	0401845F	Airborne Senior Leader C3 (SLC3S)	05		1,906	20,056	U
		System Development & Demonstration		4,138,350	4,159,289	4,219,726	
100	0604256F	Threat Simulator Development	06	35,903	34,474	27,789	U
101	0604759F	Major T&E Investment	06	62,635	69,221	60,824	U
102	0605101F	RAND Project Air Force	06	40,469	29,891	27,501	U
103	0605502F	Small Business Innovation Research	06	361,808			U
104	0605712F	Initial Operational Test & Evaluation	06	29,952	29,457	25,833	U
105	0605807F	Test and Evaluation Support	06	753,220	785,576	736,488	U
106	0605860F	Rocket Systems Launch Program (SPACE)	06	23,804	14,855	14,637	U
107	0605864F	Space Test Program (STP)	06	50,019	47,654	47,215	U
108	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support	06	61,234	46,108	52,409	U
109	0605978F	Facilities Sustainment - Test and Evaluation Support	06	33,849	29,618	29,683	U
110	0702806F	Acquisition and Management Support	06	25,630	37,014	18,947	U

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111	0804731F	General Skill Training	06	2,904		1,450	U
112	0909999F	Financing for Cancelled Account Adjustments	06	234			U
113	1001004F	International Activities	06	3,903	3,899	3,748	U
	RDT&E Management Support			1,485,564	1,127,767	1,046,524	
114	0604263F	Common Vertical Lift Support Platform	07		3,858	9,513	U
115	0605024F	Anti-Tamper Technology Executive Agency	07	12,399	20,912	47,276	U
117	0101113F	B-52 Squadrons	07	51,336	38,546	93,930	U
118	0101122F	Air-Launched Cruise Missile (ALCM)	07	4,514	395	3,652	U
119	0101126F	B-1B Squadrons	07			148,025	U
120	0101127F	B-2 Squadrons	07			415,414	U
121	0101313F	Strat War Planning System - USSTRATCOM	07	25,159	17,505	33,836	U
122	0101314F	Night Fist - USSTRATCOM	07	6,774	5,285	5,328	U
124	0102325F	Atmospheric Early Warning System	07			9,832	U
125	0102326F	Region/Sector Operation Control Center Modernization Program	07	22,628	23,793	25,734	U
126	0102823F	Strategic Aerospace Intelligence System Activities	07		15	18	U
127	0203761F	Warfighter Rapid Acquisition Process (WRAP) Rapid Transition Fund	07	21,757	20,751	11,996	U
128	0205219F	MQ-9 UAV	07	55,863	46,431	39,245	U

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129	0207040F	Multi-Platform Electronic Warfare Equipment	07			14,747	U
130	0207131F	A-10 Squadrons	07	6,498	3,989	9,697	U
131	0207133F	F-16 Squadrons	07	76,816	126,834	141,020	U
132	0207134F	F-15E Squadrons	07	114,865	198,872	311,167	U
133	0207136F	Manned Destructive Suppression	07	500	5,570	10,748	U
134	0207138F	F-22A Squadrons	07	607,785	605,659	569,345	U
135	0207161F	Tactical AIM Missiles	07	7,692	5,732	5,915	U
136	0207163F	Advanced Medium Range Air-to-Air Missile (AMRAAM)	07	36,414	54,092	49,971	U
137	0207170F	Joint Helmet Mounted Cueing System (JHMCS)	07	4,244	3,183	2,529	U
138	0207227F	Combat Rescue - Pararescue	07			2,950	U
139	0207247F	AF TENCAP	07	11,452	11,547	11,643	U
140	0207249F	Precision Attack Systems Procurement	07			2,950	U
141	0207253F	Compass Call	07	13,470	4,657	13,019	U
142	0207268F	Aircraft Engine Component Improvement Program	07	158,560	150,547	166,563	U
143	0207277F	CSAF Innovation Program	07			4,621	U
144	0207325F	Joint Air-to-Surface Standoff Missile (JASSM)	07	11,775	32,946	29,494	U
145	0207410F	Air & Space Operations Center (AOC)	07	96,593	98,566	99,405	U
146	0207412F	Control and Reporting Center (CRC)	07	24,108	58,894	52,508	U

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Line No	Program Element Number	Item	Act	FY 2008	FY 2009	FY 2010	SEC
147	0207417F	Airborne Warning and Control System (AWACS)	07	146,341	125,710	176,040	U
148	0207418F	Tactical Airborne Control Systems	07	3,366	1,526		U
149	0207423F	Advanced Communications Systems	07	30,226	29,587	63,782	U
151	0207431F	Combat Air Intelligence System Activities	07			1,475	U
152	0207438F	Theater Battle Management (TBM) C4I	07	12,079	19,384	19,067	U
153	0207445F	Fighter Tactical Data Link	07	57,424	57,264	72,106	U
154	0207446F	Bomber Tactical Data Link	07	38,280	11,603		U
155	0207448F	C2ISR Tactical Data Link	07	1,745	1,719	1,667	U
156	0207449F	Command and Control (C2) Constellation	07	42,969	31,705	26,792	U
157	0207581F	Joint Surveillance/Target Attack Radar System (JSTARS)	07	337,563	81,025	140,670	U
158	0207590F	Seek Eagle	07	22,663	21,586	22,071	U
159	0207601F	USAF Modeling and Simulation	07	20,739	28,866	27,245	U
160	0207605F	Wargaming and Simulation Centers	07	6,186	3,860	7,018	U
161	0207697F	Distributed Training and Exercises	07	6,770	7,118	6,740	U
162	0208006F	Mission Planning Systems	07	101,666	97,296	91,995	U
163	0208021F	Information Warfare Support	07	11,632	12,117	12,271	U
170	0302015F	E-4B National Airborne Operations Center (NAOC)	07	18,576	4,058	26,107	U
171	0303112F	Air Force Communications (AIRCOM)	07	2,009			U

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172	0303131F	Minimum Essential Emergency Communications Network (MEECN)	07	85,458	70,562	72,694	U
173	0303140F	Information Systems Security Program	07	178,671	189,956	196,621	U
174	0303141F	Global Combat Support System	07	14,665	5,744	3,375	U
175	0303150F	Global Command and Control System	07	3,174	3,209	3,149	U
176	0303158F	Joint Command and Control Program (JC2)	07	5,585	3,225	3,087	U
177	0303601F	MILSATCOM Terminals	07	362,676	334,182	257,693	U
179	0304260F	Airborne SIGINT Enterprise	07	138,346	173,160	176,989	U
182	0305099F	Global Air Traffic Management (GATM)	07	7,203	6,258	6,028	U
183	0305103F	Cyber Security Initiative	07		2,078	2,065	U
184	0305110F	Satellite Control Network (SPACE)	07	23,530	16,547	20,991	U
185	0305111F	Weather Service	07	39,830	47,219	33,531	U
186	0305114F	Air Traffic Control, Approach, and Landing System (ATCALS)	07	6,395	10,796	9,006	U
187	0305116F	Aerial Targets	07	5,683	34,683	54,807	U
190	0305128F	Security and Investigative Activities	07	1,922	784	742	U
192	0305146F	Defense Joint Counterintelligence Activities	07		39	39	U
194	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	07	150,979	126,712	137,692	U
195	0305165F	NAVSTAR Global Positioning System (Space and Control Segments)	07	110,224	90,711	52,039	U

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197	0305173F	Space and Missile Test and Evaluation Center	07	4,986	1,967	3,599	U
198	0305174F	Space Warfare Center	07	1,622	2,974	3,009	U
199	0305182F	Spacelift Range System (SPACE)	07	25,089	12,322	9,957	U
200	0305193F	Intelligence Support to Information Operations (IO)	07	8,312	3,627	1,240	U
201	0305202F	Dragon U-2	07	608			U
202	0305205F	Endurance Unmanned Aerial Vehicles	07			73,736	U
203	0305206F	Airborne Reconnaissance Systems	07	111,842	103,870	143,892	U
204	0305207F	Manned Reconnaissance Systems	07	24,333	17,811	12,846	U
205	0305208F	Distributed Common Ground/Surface Systems	07	100,330	105,272	82,765	U
206	0305219F	MQ-1 Predator A UAV	07	37,642	36,906	18,101	U
207	0305220F	RQ-4 UAV	07	274,729	310,664	317,316	U
208	0305221F	Network-Centric Collaborative Targeting	07	12,035	8,783	8,160	U
209	0305265F	GPS III Space Segment	07		392,276	815,095	U
210	0305614F	JSpOC Mission System	07			131,271	U
211	0305887F	Intelligence Support to Information Warfare	07	5,163	5,401	5,267	U
212	0305906F	NCMC - TW/AA System	07	11,417			U
213	0305913F	NUDET Detection System (SPACE)	07	38,279	41,102	84,021	U
214	0305924F	National Security Space Office	07	15,104	7,587	10,634	U
215	0305940F	Space Situation Awareness Operations	07	38,679	15,579	54,648	U

Exhibit R-1: Total (Direct and Supplementals), as of May 5, 2009 at 12:28:14

Department of the Air Force
FY 2010/2011 President's Budget
Exhibit R-1
(Dollars in Thousands)

APPROPRIATION: 3600F Research, Development, Test & Eval, AF — Date: 05 MAY 2009

Line No	Program Element Number	Item	Act	FY 2008	FY 2009	FY 2010	SEC
216	0307141F	Information Operations Technology Integration & Tool Development	07	21,348	15,683	30,076	U
217	0308699F	Shared Early Warning (SEW)	07	3,044	3,143	3,082	U
218	0401115F	C-130 Airlift Squadron	07	233,309	179,272	201,250	U
219	0401119F	C-5 Airlift Squadrons (IF)	07	173,960	127,118	95,266	U
220	0401130F	C-17 Aircraft (IF)	07	166,217	235,407	161,855	U
221	0401132F	C-130J Program	07	62,106	27,280	30,019	U
222	0401134F	Large Aircraft IR Countermeasures (LAIRCM)	07	17,557	36,401	31,784	U
223	0401218F	KC-135s	07	7,825	10,305	10,297	U
224	0401219F	KC-10s	07	13,510		35,586	U
225	0401221F	KC-135 Tanker Replacement	07	29,686			U
226	0401314F	Operational Support Airlift	07	3,870		4,916	U
227	0401839F	Air Mobility Tactical Data Link	07	4,300	7,923		U
228	0408011F	Special Tactics / Combat Control	07	7,868	7,707	8,222	U
229	0702207F	Depot Maintenance (Non-IF)	07	1,459	1,527	1,508	U
230	0702976F	Facilities Restoration & Modernization - Logistics	07		44,778		U
231	0708011F	Industrial Preparedness	07	48,987			U
232	0708610F	Logistics Information Technology (LOGIT)	07	104,817	159,246	246,483	U
233	0708611F	Support Systems Development	07	35,981	15,820	6,288	U
234	0804743F	Other Flight Training	07			805	U
235	0804757F	Joint National Training Center	07	3,021	3,205	3,220	U

Exhibit R-1: Total (Direct and Supplementals), as of May 5, 2009 at 12:28:14

Department of the Air Force
FY 2010/2011 President's Budget
Exhibit R-1
(Dollars in Thousands)

APPROPRIATION: 3600F Research, Development, Test & Eval, AF — Date: 05 MAY 2009

Line No	Program Element Number	Item	Act	FY 2008	FY 2009	FY 2010	SEC
236	0804772F	Training Developments	07			1,769	U
237	0808716F	Other Personnel Activities	07	114	1,113	116	U
238	0901202F	Joint Personnel Recovery Agency	07	5,192	5,752	6,376	U
239	0901212F	Service-Wide Support (Not Otherwise Accounted For)	07	6,454	3,008		U
240	0901218F	Civilian Compensation Program	07	13,328	8,101	8,174	U
241	0901220F	Personnel Administration	07	22,944	18,575	10,492	U
242	0901538F	Financial Management Information Systems Development	07	28,635	16,737	55,991	U
9999	9999999999	Classified Programs		10,792,066	11,651,275	11,955,084	U
		Operational Systems Development		15,883,545	16,834,385	18,751,901	
		Total Research, Development, Test & Eval, AF		26,346,815	27,052,221	27,992,827	

Exhibit R-1: Total (Direct and Supplementals), as of May 5, 2009 at 12:28:14

PROGRAM ELEMENT COMPARISON SUMMARY

PROGRAM ELEMENT (By BUDGET ACTIVITY)		REMARKS
BUDGET ACTIVITY #1: BASIC RESEARCH (Volume 1)		
0601102F	Defense Research Sciences	In FY 2010, efforts will move from this Project to Projects 2307 and 2311 within this PE to more accurately align basic research efforts in the Fluid Dynamics and Information Science disciplines, respectively. Note: In FY 2010, efforts were moved from this Project to Projects 2306 and 2308 within this PE to more accurately align basic research efforts in the Materials and Propulsion disciplines, respectively. In FY 2010, efforts in building and testing mathematical descriptions of cognitive decision-making moved from Project 2313 in this PE to this Project to more accurately align basic research efforts in Information Services. In FY 2010, Bioenergy and Catalysis efforts from Project 2312 in this PE moved to this Project to more accurately align basic research efforts in Propulsion. In FY 2010, Natural Flight Control and Navigation efforts from Project 2313 in this PE moved to this Project to more accurately align basic research efforts in Fluid Mechanics.
BUDGET ACTIVITY #2: APPLIED RESEARCH (Volume 1)		
0602102F	Materials	In FY 2010 and out, funds from Project 01SP have been moved to Project 4347, Project 4348, and Project 4349 within this Program Element to more accurately align efforts.
0602202F	Human Effectiveness Applied Research	In FY 2010, Human Dynamics Evaluation efforts will move from Project 7184 to Project 5328, Sensory Evaluation and Decision Science efforts will move from Project 7184 to Project 5329, and Performance Evaluation in Extreme Environments efforts within Project 7757 will move to Project 7184 to better align efforts.
0602203F	Aerospace Propulsion	In FY 2010. The fuels portion of this Project will be moved to Project 5330 within this Program Elemen to more accurately align efforts with organizational structure. In FY10, work was moved to PE 0602203F Project 4847 to more accurately align efforts. In FY2010 The funding in this project will be transferred in from 62203F Project 3048 to more accurately align efforts with organizational structure.
0602204F	Aerospace Sensors	In FY 2010, funds from Project 44SP are being moved to Projects 2002, 2003, and 7622 to better align efforts.
0602605F	Directed Energy Technology	In FY 2010, the efforts that had been in Project 55SP, Laser and Imaging Space Technology have been moved to this project to allow better integration of directed energy efforts. Also in FY 2010 several electric laser, relay mirror, and space situational awareness efforts in PE 0603605F, Advanced Weapons Technology, have been moved into this project to better reflect the actual technology readiness level of the efforts. In FY 2010, the efforts in this project are being moved to Project 4866, Lasers & Imaging Technology to better align efforts.
0602702F	Command Control and Communications	In FY 2010, efforts in this PE move to PE 0602788F, Dominant Information Technology. In FY 2010, this effort moves to PE 0602788F, Project 5316, Info Mgmt and Computational Tech. In FY 2010, these efforts move to PE 0602788, Project 5318, Operational Awareness Tech, and Project 5317, Information Decision Making Tech. In FY 2010, this effort moves to PE 0602788F, Project 5315, Connectivity and Protection Tech.
BUDGET ACTIVITY #3: ADVANCED TECHNOLOGY DEVELOPMENT (Volume 1)		
0603203F	Advanced Aerospace Sensors	In FY 2010, funds from Project 88SP are being moved to Projects 665A and 69DF to better align efforts.
0603216F	Aerospace Propulsion and Power Technology	In FY10, The funding has been increased due to emphasis on component development in support of adaptive cycle demonstrations, highly efficient embedded turbine engines, and small heavy fueled engines. In FY10, this work was moved from Project 10SP within this Program Element to better align efforts. In FY10 and beyond, this work was moved to Project 4922 within this Program Element to better align efforts.

0603231F	Crew Systems and Personnel Protection Technology	In FY 2010, Decision Effectiveness Technology efforts will move from PE 0603231F, Project 2830 to PE 0603456F, Project 5324, Project 5326, and Project 5327; Warfighter Readiness Technology efforts will move from PE 0603231F, Project 4924 to PE 0603456F, Project 5325; and Bioeffects & Protection Technology efforts will move from PE 0603231F, Project 5020 to PE 0603456F, Project 5323 and Project 5326 to better align efforts.
0603456F	Human Effectiveness Adv Tech Dev	In FY 2010, Directed Energy Bioeffects Parameters efforts will move from PE 0603231F, Project 5020 to PE 0603456F, Project 5323; Human Dynamics and Terrain Demonstration efforts will move from PE 0603231F, Project 2830 to PE 0603456F, Project 5324; Mission Effective Performance efforts will move from PE 0603231F, Project 4924 to PE 0603456F, Project 5325; Performance Enhancement Demonstration efforts will move from PE 0603231F, Project 2830 and Project 5020 to PE 0603456F, Project 5326; and Warfighter Interfaces efforts will move from PE 0603231F, Project 2830 to PE 0603456F, Project 5327 to better align efforts.
0603605F	Advanced Weapons Technology	In FY 2010, some of the efforts from Project 11SP, Advanced Optics and Laser Space Technology, are being moved to this Project to better align efforts. Also in FY 2010, some of the electric laser, relay mirror, and space situational awareness efforts in this project have been moved into PE 0602605F, Directed Energy Technology, to better reflect the technology readiness level of the efforts.
0603789F	C3I Advanced Development	In FY 2010 efforts moves to PE 0603788F, Project 5321, Global Battlespace Awareness, Project 5322, Knowledge Management and Computing, and Project 5319, Anticipatory Ops Intent and Response.

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

0603845F	Transformational SATCOM (TSAT)	In FY2010, Project #4944, Advanced Wideband System, was terminated.
0604283F	BMC2 Sensor Development	In FY 2010, Project 5363, MP-RTIP, efforts were transferred from PE 0207581F, PE Joint STARS, Project 0003, in order to continue risk reduction on a Wide Area Surveillance (WAS) radar and supporting Battle Management Command and Control (BMC2).
0604635F	Ground Attack Weapons Fuze Development	In FY 2010, Project 645312, Hard target Void Sensing Fuze is a new start effort.

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

0207434F	Link 16 Suport and Sustainment	In FY2010, Project 655050 and 655262 moved from Program Element 0207434F Link 16 Support and Sustainment to Program Element 0604281F Tactical Data Networks Enterprise.
0207451F	Single Integrated Air Picture (SIAP)	In FY2010, efforts to develop and complete the Joint Track Manager were transferred to PE 0605452F, Joint SIAP Executive Program Office, Project 5370.
0604226F	B-1B	In FY2010, B-1B development efforts are transferring from PE 0604226F, Budget Program Activity Code (BPAC) 654596 to B-1B Squadrons, PE 0101126F, BPAC 675344. This transfers funds / efforts from Budget Activity (BA) 5 Demonstration / Validation to BA 7 Operations Systems Development.
0604240F	B-2 Advanced Technolgy Bomber	In FY 2010, Project Number 653843, B-2 Advanced Technology Bomber efforts are transfering from PE 0604240F, B-2 Advanced Technology Bomber, to PE 0101127F, B-2 Squadrons, transferring funds/efforts from MFP 6 to MFP 1.
0604270F	EW Development	In FY 2010, MALD-J is broken out in Project 655305, MALD-J.
0604281F	Tactical Data Networks Enterprise	In FY2010, Project 655050 and 655262 moved from Program Element 0207434F Link 16 Support and Sustainment to this Program Element.
0604421F	Counterspace Systems	In FY 2010, Program 65A024, RAIDRS Block 20 content and funding were transferred to PE 0305614F, Joint Space Operations Center (JSpOC) Mission Systems

0604425F	Space Situation Awareness Systems	In FY 2010, Space Situation Awareness Environmental Monitoring (SSAEM), 65A038, is a new project . Space Surveillance Telescope, 65A037, is a new project in FY10. Net-centric Sensors and Data Sources, 65A012, is a new project in FY10, with the exception of the ESSA ACTD transition effort which was included previously in the ISSA program and is now associated with the JSpOC Mission System in PE 35614F. Beginning in FY10 efforts formerly in the ISSA project have transferred to the JSpOC Mission System (JMS), PE 35164F, except for the ESSA ACTD, which is now executed in the Net-Centric Sensors and Data Sources project.
0604602F		In FY 2010, Project 5361, Stores-Aircraft Interface (new), efforts were transferred from PE 0605011F, RDT&E for Aging Aircraft, Project 654685, Universal Armament Interface (UAI), in order to properly fund the maturing technology.
0604617F	Agile Combat Support	In FY2010, Project 652895, Civil Engineering Readiness (CE), and Project 654910, Aeromedical Readiness, include New-Start efforts.
0604853F	Evolved Expendable Lauch Vehicle - EMD	In FY2010, PE0604853F, Evolved Expendable Launch Vehicle (EELV) includes New Start efforts for Pre-Planned Product Improvements to sustain the EELV capability through 2030.
0605452F	Joint SIAP Program Executive Office	In FY2010, this is a new PE. Joint Program Executive Office (JPEO) Single Integrated Air Picture (SIAP) funding was transferred from Air Force Program Element 0207451F, Single Integrated Air Picture (SIAP), Joint SIAP Engineering and Development, to Air Force Program Element 0605452F, Joint Program Executive Office (JPEO) SIAP, in accordance with Department of Defense designation of the Air Force as the SIAP Acquisition Executive. As a result, funding was placed in the JPEO SIAP line for ongoing development of the Joint Track Manager (JTM) in FY10. The Quadrennial Defense Review (QDR) Analysis will assess the path forward by leveraging existing SIAP technologies and the Cooperative Engagement Capability (CEC) and Tactical Component Network (TCN) programs.

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

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

0305219F	Predator Development/Fielding	In FY 2010 funding totals do not include $1.4M requested for Overseas Contingency Operations.
0401130F	C-17 Aircraft	In FY2010, 672569, C-17 Aircraft development includes new start efforts.
0708011F	Industrial Preparedness	In FY 2010, research efforts in Projects 2312 and 2313 moved to Projects 2306, 2307, 2308, and 2311 in this PE to more accurately align them to the Projects they support.
0207410F	Air and Space Operations Center -Weapon System (AOC-WS)	In FY2010, Project 674372, Space C2 Operations efforts transferred to PE 0305614F, JSpOC Mission Systems (JMS). In FY10, Project 675242, Command and Control Air Replanning and Monitoring (C2ARM) efforts transferred to Project 675218, Applications Development, to better align C2 capability development projects and programs.
0207325F	Joint Air to Surface Standoff Missile (JASSM)	In FY2010 this PE is broken out in 3 projects given above. Last year all RDT&E was funded in project 4515. This is a new project, starting in FY10.
0207268F	Aircraft Engine Component Improvement Program (CIP)	In FY 2010, - Project 675365 is new in FY10 to provide enhanced funds tracking and accountability for the F135 engine (F-35). Previously, all Engine CIP work was accomplished entirely within Project 671012.
0207134F	F-15E SQUADDRONS	In FY 2010, The F-15 program has one FY 2010 new start: F-15C/D Infrared Search and Track (IRST) develops and procures a new air-to-air sensor.
0305940F	Space Situtation Awareness Operations	In FY2010, The GEODSS and Globus II service life extension programs are new starts in FY10.
0205219F	MQ-9 Development and Fielding	In FY 2010 funding totals do not include $1.4M requested for Overseas Contingency Operations.

0305265F	GPS III Space Segment	In FY2010,funding from 2 OCX PEs (0603423F and 0603427F) consolidated into separate BPAC in this PE.
0207249F	Precision Attack Systems	In FY2010, Project 675347, Advanced Targeting Pod includes new start efforts.
0101126F	B-1B SQUADRONS	In FY2010, B-1B development efforts are transferring from PE 0604226F, Budget Program Activity Code (BPAC) 654596 to B-1B Squadrons, PE 0101126F, BPAC 675344. This transfers funds / efforts from Budget Activity (BA) 5 Demonstration / Validation to BA 7 Operations Systems Development.
0305205F	Endurance Unmanned Aerial Vehicles	In FY 2010, Project 5372, Integrated Sensor Is Structure, includes new start efforts.
0207412F	Control and Reporting Center (CRC)	IN FY2010, within PE 0207412F, partial funding was transferred from Project Number 485L, Project Title Control and Reporting Center (CRC), to Project Number 5294, Project Title Theater Air Control System Improvement - Radar (TACSI-R), to continue development of the AN/TPS-75 sensor replacement/upgrade, known as Three Dimensional Expeditionary Long Range Radar (3DELRR).
0303140F	Information System Security Program	In FY2010, Key Management Equipment Modernization (KMEM) concept refinement and development transfers to ISSP Project 675231, AF KMI, for integral KMI development. The KMEM project develops the KOV-21 follow-on crypto engine that will be utilized with the KMI next generation fill device" under development."
0304260F	Airborne SIGINT Enterprise (JMIP)	In FY2010, Funding decreased in FY10 to reflect the SIGINT Capabilities Working Group (SCWG) priorities and the accomplishment of other ASE initiatives.
0101313F	STRAT WAR PLANNING SYS- USSTRATCOM	In FY2010 Project 5368, Global Sensor Integrated Network (GSIN) transferred from PE 0105921F, Service Support to STRATCOM Space Activities, in order to better align effort and appropriation.
0305614F	JSpOC Mission System	In FY2010, JSpOC Mission System is a new program element. It consolidates on-going efforts from PE 64425F (Integrated Space Situational Awareness (ISSA), PE 64421F (RAIDRS Block 20), and PE 27410F (Space Command and Control) into a single program element as the programs were consolidated into a single program. This program will also develop improved, responsive, and accurate orbital collision predictions for commercial and international space systems.

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

Program Element	Title
0101314F	NIGHT FIST- USSTRATCOM
0101815F	Advanced Strategic Program
0207424F	Evaluation and Analysis Program
0208161F	Special Evalution System
0301310F	National Air Intelligence Center
0301314F	COBRA BALL
0301315F	Missile and Space Techincal Collection
0301324F	FOREST GREEN
0301386F	GDIP Collection Management
0301555F	Classified Programs
0301556F	Special Program
0304111F	Special Activities
0304311F	Selected Activities
0304348F	Advanced Geospatial Intelligence (AGI)
0305124F	Special Applications Program
0305142F	Applied Technolgy and Integration
0305159F	Defense Reconnaissance Support Activities
0305172F	Combined Advanced Applications
0605798F	Analysis Support Group
0305127F	Foreign Counterintelligence Activites

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.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research					R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	275.207	313.845	321.028						Continuing	Continuing
612301: Physics	47.502	48.851	46.971						Continuing	Continuing
612302: Solid Mechanics and Structures	16.074	17.978	19.747						Continuing	Continuing
612303: Chemistry	32.089	38.125	39.118						Continuing	Continuing
612304: Mathematics and Computing Sciences	23.019	30.500	33.345						Continuing	Continuing
612305: Electronics	31.489	39.179	40.568						Continuing	Continuing
612306: Materials	36.069	25.609	29.442						Continuing	Continuing
612307: Fluid Mechanics	13.652	20.429	24.213						Continuing	Continuing
612308: Propulsion	20.145	26.159	31.447						Continuing	Continuing
612311: Information Sciences	24.081	31.551	46.436						Continuing	Continuing
612312: Biological Sciences	9.736	10.444	0.000						Continuing	Continuing
612313: Human Performance	10.569	15.213	0.000						Continuing	Continuing
614113: External Research Programs Interface	10.782	9.807	9.741						Continuing	Continuing

Note

Note: In FY 2010, research efforts in Projects 2312 and 2313 moved to Projects 2306, 2307, 2308, and 2311 in this PE to more accurately align them to the Projects they support.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	**R-1 ITEM NOMENCLATURE** PE 0601102F Defense Research Sciences

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. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	288.601	309.926	322.878	
Current BES/President's Budget	275.207	313.845	325.912	
Total Adjustments	-13.394	3.919	0.000	
Congressional Program Reductions	0.000	-0.027		
Congressional Rescissions	0.000	-0.854		
Total Congressional Increases	0.000	4.800		
Total Reprogrammings	-6.826	0.000		
SBIR/STTR Transfer	-6.568	0.000		

Change Summary Explanation

Note: In FY 2009, Congress added $0.8 million for Chabot Space and Science Center, $5.0 million for High Energy Laser for Detection, Inspection and Non-Destructive Testing, $2 million for Nanotechnology Based Biosensors and Biothreat Detectors, $0.7 million for UNR (University of Nevada-Reno)-Millimeter Wave-Based Fatigue Countermeasure Technology, $1.6million for Fully-Integrated Solar-Powered Interior Lighting Technology, $1.0 million for Process Integrated Mechanism for Human-Computer Collaboration and Coordination, $1.6 million for Hybrid Materials for Thermal Management in Thin Films and Bulk Composites, $16.0 million for National Aerospace Leadership Initiative, $2.4 million for Development and Validation of Advanced Design Technologies for Hypersonic Research, and $1.0 million for Coal Transformation Laboratory.

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences					PROJECT NUMBER 612301	
COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
612301: Physics	47.502	48.851	46.971						Continuing	Continuing

Note

Note: Space Environment efforts from Project 2311 and Physical Mathematics efforts from Project 2304 moved to this Project in FY 2008 to more accuarately align basic research efforts in Physics.

A. Mission Description and Budget Item Justification

Physics basic research seeks to enable revolutionary advances in, and expand the fundamental knowledge of 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Investigate regulated, broad-spectrum, variable-energy lasers, laser arrays, and multi-aperture adaptive optics. In FY 2008: Studied mechanical, optical, and laser properties of ceramic materials as a function of material and preparation parameters. Investigated novel index, gain, and doping profiles for high power, high beam, quality ceramic lasing. Studied means for efficiently producing and making available quasi-phase matched semiconductor crystals for tunable high energy lasing. Studied 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. In FY 2009: Investigate applications of previous research enabling large inexpensive, very bright 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, and all solid state lasers. Study direct-write micro-systems, including on-board power sources. Apply 3-D laser write techniques in special glasses to inexpensive, flexible subsystems for space.	9.041	10.609	10.778	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 612301

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Extend high energy solid-state laser research into new materials and materials processing procedures to increase the average power and tunability range of ceramic lasers. Study novel optical fiber geometries to achieve single mode operation in large core area, thereby allowing high power operation. Study novel techniques for alleviating deleterious nonlinear optical effects in high power, single mode fiber lasers, and novel means to couple such lasers for very high powers.				
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. In FY 2008: Explored 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. Explored the possibility of tailor-making materials using the results of research in the overlap between atomic physics and condensed matter physics. Studied new concepts for high-power, high-frequency electromagnetic radiation sources. Studied quantum physics effects relating to the emission of electrons from surfaces. Examined the application of Chaos Theory effects to raise fundamental limits on electrical energy storage density. Studied the seamless integration of magnetohydrodynamic and particle-in-cell modeling algorithms to better capture the detailed physics of high power microwave sources. 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	12.635	14.216	13.857	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 612301

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2010: Continue to investigate compact sources of pulsed radiation in the regimes of high-frequency (e.g., X-rays and beyond) and very high peak-power sources of both electromagnetic and particle radiation (e.g., electrons). For precision navigation applications, continue to study compact atom interferometry. Explore the possibility of achieving precision beyond the standard quantum limit (i.e., the shot noise limit) by generating and utilizing entangled states of atoms. Continue to develop frequency comb techniques for precision sensing and metrology, as well as cold and ultracold atom based techniques. Explore properties of ultracold molecules for precision measurement applications. Investigate slow and stopped light processes for improving optical communication. Continue to explore the possibility of tailor-making materials, including novel states of matter, using the results of research in the overlap between atomic physics and condensed matter physics. Move from microfabrication to nanofabrication methodologies to achieve higher frequencies in compact, high-power electromagnetic radiation sources. Exploit new knowledge of quantum-level electron emission physics to create new generation of low work function field-emission (cold) high current density cathodes. Enhance new simulation code algorithms to full 3-dimensional hybrid modeling of high power microwave sources.				
MAJOR THRUST: Advance technologies for space sensors, imaging, identification and tracking methods, and effective space situational awareness. In FY 2008: Developed theoretical approaches to the surveillance and identification of space objects from both the ground and from space. Continued to study propagation of electromagnetic energy, image formation, image recovery, and information content maximization from both ground-based and space-based sensors. Investigated methods to mitigate environmental effects on sensors and sensor systems. Investigated atmospheric density forecast models to improve satellite orbit determination and tracking. In FY 2009: Continue to investigate fundamental limits affecting ground-based 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.	4.493	5.871	5.948	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences			PROJECT NUMBER 612301	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2010: Investigate new sensing modalities to improve resolution and precision limits of ground-based and space-based surveillance of space objects. Continue study of spectral, polarimetric, and temporal signatures of space objects to identify unresolved space objects. Investigate physics involved in active imaging techniques. Investigate inclusion of fundamental processes of the solar-terrestrial system into physics-based models to predict atmospheric density and increase precision of satellite orbit prediction and precision tracking.					
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, and better space-based communications and quantifying the risks to space systems. In FY 2008: Began 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. Investigated fundamental plasma modeling theory using new grid-free, full kinetic modeling techniques and developed novel techniques to include electromagnetism. Continued development of ground-based and space-based sensor technology for remote sensing and in situ measurement of space weather conditions. Continued 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. Continued 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. Continued to analyze data from DoD surveillance satellites to improve remote sensing of interplanetary space. Maintained focused research to investigate the neutral densities and winds above 150 kilometers. In FY 2009: Study 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		4.722	6.110	6.202	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
astronomy techniques for remote sensing the space environment. Continued search for understanding of fundamental physics and processes controlling solar, heliospheric, magnetospheric ionospheric, and thermospheric environments. 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. 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. In FY 2010: Continue developing of methods to sense atmospheric and ionospheric quantities using small, inexpensive satellites. Continue the study of space plasmas using grid-free modeling techniques. Investigate fundamental processes to enable the forecasting of the near-Earth space environment. Investigate coupling and dependencies of the various environments from the sun through the Earth's atmosphere that would enable the understanding of energy flow throughout the various regions. Investigate plasma instabilities in the equatorial and polar regions that degrade communication and navigation signals. Expand the study of neutral densities and winds that affect satellite drag.					
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 operational settings. In FY 2008: Continued 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. Continued to develop algorithms to simulate nonlinear optical effects within fiber lasers and nonlinear optical media with an emphasis on designs for 100KW laser weapons. Continued to investigate the dynamics of		8.501	10.045	10.186	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
transonic/supersonic/hypersonic platforms with an emphasis on stores release. Modeled 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. Studied the design of reconfigurable warheads through suitable timing/placement of micro-detonators together with effects of metal particle inclusions. Improved 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. Pursued the design of electromagnetic sources which, with the help of novel materials, can transmit optimized waveforms for a variety of surveillance purposes. 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. Study electromagnetic sources interaction with novel materials for transmitting optimized waveforms for surveillance. In FY 2010: Study the susceptibility of electronic circuits exposed to electromagnetic waveforms. Continue to pursue an understanding of the propagation of ultra-short laser pulses through the atmosphere. Exploit terahertz radiation, and components of laser-guided bombs or ladar when cloud cover is present. Increase researching electromagnetic waveforms from the perspective of dispersive media (foliage, clouds, buildings, airplane boundary layers). Objective is to improve spatial resolution of objects obscured by such media.				
CONGRESSIONAL ADD: Chabot Space and Science Center.	0.763	0.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Developed new science programs for K-12 students, teachers, and the general public. In FY 2009: Not Applicable. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: High Energy Laser for Detection, Inspection and Non-Destructive Testing. In FY 2008: Conducted laser technology research to support multiple applications, including inspection of military hardware and equipment flaws, and detecting weapons hidden in cargo ships. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		4.771	0.000	0.000	
CONGRESSIONAL ADD: Nanotechnology Based Biosensors and Bio-Threat Detectors In FY 2008: Researched how to remotely control the operation of both nanofabrication equipment and nanoscale analysis tools while performing new nano related science field. In addition, a significant number of minority engineers will be trained in nanotechnology research area. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.908	0.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: UNR - Millimeter Wave-Based Fatigue Countermeasure Technology. In FY 2008: Developed a novel device based on millimeter wave technology that will serve as a skeletal muscle fatigue countermeasure for use in the battlefield. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	0.668	0.000	0.000	
CONGRESSIONAL ADD: Center for Microplasma Science and Technology (CMST) In FY 2008: Not Applicable. In FY 2009: Create a National Center for the microplasma research field. In FY 2010: Not Applicable.	0.000	2.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Technology.	0.000	0.000							Continuing	Continuing
PE 0602601F/ Space Technology.	0.000	0.000							Continuing	Continuing
PE 0602605F/ Directed Energy Technology.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences					PROJECT NUMBER 612302	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
612302: Solid Mechanics and Structures	16.074	17.978	19.747						Continuing	Continuing

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. 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Expanded research in the area of multifunctional composite systems with structurally integrated antenna functions of broad bandwidth and improved structural endurance. Continued research in the areas of diagnostics, prognostics, autonomics, self-healing, thermal management, energy harvesting/storage, and micro-/nano-mechanics enabled safer and more durable aerospace structures with improved performance characteristics. Further developed the fundamental knowledge required to design and manufacture multifunctional aerospace material systems and devices and to predict their performance and structural integrity. Developed and exploited methods that combined information technology and multi-scale modeling in the design of new material systems and devices. 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	7.622	8.578	7.561	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2010: Expand research in the area of multifunctional materials and microsystems for reconfigurable structures allowing shape change and property tuning. 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.					
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). In FY 2008: Developed novel theoretical and experimental methods for constructing and modeling morphing structures that broaden system operational capabilities. Continued development of novel actuation devices and materials for a variety of Air Force applications to aircraft and space structures. Studied the science issues related to the introduction into new structural concepts of the novel materials developed under the advanced materials programs. Used the knowledge acquired about the novel materials to develop new aerospace structural concepts. Developed an integrated approach to structural systems lifetime prognosis. Continued the development of structural health monitoring sensors and techniques towards an integrated vehicle-wide approach. Consolidated the exploration of mechanical and dynamic behavior of micro-/nano-scale structures. Expanded the investigation of nonlinear phenomena associated with the structural deformation and aero-elastic instabilities and limit-cycle vibration to include novel structural concepts.		8.452	9.400	12.186	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Continue the development of structural health monitoring sensors and techniques towards an integrated vehicle-wide approach. 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. In FY 2010: Search for unprecedented new and revolutionary flight structure concepts that will permit broader operational capabilities, a faster reconfigurable ability, and more affordable accelerated fabrication; this search will include morphing aircraft structures. Investigate novel actuation devices and materials for Air Force aircraft and space structural applications. Expand scientific knowledge related to new structures of the novel materials developed under the advanced materials programs. Expand development of structural health monitoring sensors and techniques towards an integrated vehicle health monitoring and operational capability prognosis. Understand a risk-based approach to structural systems lifetime prognosis and reliability. Expand understanding of mechanical and dynamic behavior of flight structures under extreme environments (e.g., intense vibration, nonlinear structural dynamics, unsteady aero-thermo-elastic effects on flight structure, and directed energy) with objective of enhancing operational survivability and mission success.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0602201F/ Aerospace Flight Dynamics.	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0603211F/ Aerospace Structures.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences					PROJECT NUMBER 612303	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
612303: Chemistry	32.089	38.125	39.118						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2008: Developed new theoretical and computational methods to enhance capabilities to predict and simulate properties of chemicals and materials of interest to the Air Force. Continued to develop new experimental methods to advance understanding of reactivity and energy flow in molecules for applications to signatures, battle space awareness, propellants, munitions, and laser systems. Explored ability to understand and control catalysis and plasmonic structures to enhance propulsion and energetic applications and sensitive detection of target compounds. 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, battle space awareness, propellants, munitions, and laser systems. Continue to	13.790	16.402	16.543	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences			PROJECT NUMBER 612303	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
develop novel applications of catalysis and plasmonic structures for applications to propulsion, energetics, and sensing. Explore new concepts for closed-cycle hybrid chemical lasers. In FY 2010: Advance the development of experimental and theoretical methods to understand and control chemical reactivity and energy in molecular systems. Develop the understanding of catalytic mechanisms in systems that can improve energy utilization in propulsion applications. Explore synthetic methods and computational screening procedures to streamline the production of novel propellants. Investigate methods for producing energetic metastable species and analyzing their lifetimes. Explore the mechanisms of processes induced by plasmonic structures and its impact on chemical processes. Perform experiments and theoretical analysis to provide benchmarks for models of chemistry in the space environment. Investigate novel approaches for high-power hybrid electric-chemical lasers.					
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. In FY 2008: Explored power generation and power storage for warfighters based on improved polymers for solar cells and fuel cells applications. Continued to explore photonic polymers and conductive polymers for communications and detections. Investigated 3-D displays based on photorefractive polymers. Polymers with controlled dielectric permittivity and magnetic permeability were explored for advanced radar antenna applications. Controlled growth mechanisms of carbon single wall nanotubes were investigated. 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. Control synthesis of new polymers with improved power generation and storage 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.		9.689	12.221	12.698	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Further exploit advances in nanotechnology to improve properties of magneto-dielectric materials for antenna substrate applications. Explore hybrid materials approach to enhance optical limiting behavior and optical filtering response for broadband laser protection applications. Improve charge mobility of organic transistors to enable higher speed responses for Air Force applications.				
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. In FY 2008: Developed 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. Continued to investigate phenomena at surface interfaces, including friction and wear, lubrication, corrosion, and degradation. Explored novel approaches to corrosion prevention, particularly multi-disciplinary efforts that combine corrosion initiation, detection, and lifetime prediction. Continued tribological investigations that focus on bridging the fundamental gap between macro- and nano-scale mechanisms, including heat transfer, chemical reactivity, and atmospheric effects. Continued to investigate nano-scale surface structures for power applications. 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, 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 nano-composite lubricants that provide function over a wide variety of extreme environments, including space. In FY 2010: Continue to develop theoretical and predictive methods for the fundamental understanding of the structure and reactivity of surfaces and interfaces, particularly under non-equilibrium conditions. Continue to investigate phenomena at surfaces and interfaces, including the fundamental mechanisms of friction and wear, lubrication, corrosion, material degradation in extreme environments, and thermal transport. Develop methods for understanding and controlling interfacial chemistry in the creation of complex materials, including	7.089	9.502	9.877	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
nano-composite lubricants that provide function over a wide variety of extreme environments. Develop instrumentation and methodologies capable of examining surface chemistry and kinetics with high spatial resolution.					
CONGRESSIONAL ADD: Fully-Integrated Solar-Powered Interior Lighting Technology. In FY 2008: Continued to conduct research to integrate solar-energy-generating photovoltaic materials and light-emitting organic materials for self-contained lighting systems for combat locations. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.521	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 612303

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Technology.	0.000	0.000							Continuing	Continuing
PE 0602601F/ Space Technology.	0.000	0.000							Continuing	Continuing
PE 0602602F/ Conventional Munitions.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences					PROJECT NUMBER 612304	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
612304: Mathematics and Computing Sciences	23.019	30.500	33.345						Continuing	Continuing

Note

Note:

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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 in basic research on complex systems' control and dynamics necessitate resource increases in this major thrust. In FY 2008: Investigated emerging novel approaches for cooperative control systems in dynamic, uncertain, adversarial environments with applications to swarms of smart munitions, unattended aerial vehicles (UAVs), and constellations of small satellites. Conducted additional research for teams of micro air vehicles operating at various altitudes in complex environments to execute assigned missions with variable operator intervention. Advanced control methodologies and modeling to improve non-equilibrium behavior of complex, unsteady fluid systems with applications for combustion, materials processing, and agile autonomous flight. Continued to advance image processing and sensor technologies for use in UAV controllers, smart munitions, and non-destructive vehicle testing. Advanced methods for design and analysis of bio-inspired sensing systems, controls, and computational systems. Continued development of algorithms for control of and over dynamic, large-scale networks. Investigated theory and algorithms for specification, design, verification, and validation of	11.376	15.564	16.820	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 612304

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
distributed embedded systems. Researched potential devices to exploit nonlinear dynamic phenomena with a focus on detection, classification, and control systems for use in urban combat environments. 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 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. In FY 2010: 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 with an emphasis on heterogeneous agents and mixed human-robot interactions. Expand additional research for teams of micro air vehicles operating at various altitudes in complex environments to execute assigned missions with variable operator intervention to include adaptive control and machine learning. Develop control methodologies to improve non-equilibrium behavior of complex, nonlinear systems. Continue to advance image processing and sensor technologies for use in UAV controllers and smart munitions to include target tracking and ownship state estimation. Develop mathematical control theoretic models that capture the robust, nonlinear, hybrid dynamics of microbiological systems. 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 control systems.				
	10.695	14.936	16.525	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Continued 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 battle space information management. Approaches included both rigorous analytical tools and meta heuristic searches. Continued 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 included aerodynamics for various flight regimes, high power microwaves, material design, and structural mechanics. Continued 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. Enhanced uncertainty quantification based on rigorous error analysis in non-linear models of aerodynamic flows and structural failure predictions. Developed mathematical models that dynamically evolved and dealt with operational data that were incomplete, uncertain, conflicting, or overlapping. 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 battle space 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 are dynamically evolving that would deal with operational data that are possibly incomplete, uncertain, conflicting, or overlapping.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Continue to develop theoretically rigorous and computationally effective mathematical methods for solving large and complex problems in logistics, system diagnostics/prognostics, air mobility contingencies, engineering design, target tracking, and strategic/tactical planning for battle space information management. Meta heuristic searches are combined with rigorous methods and emphasis is placed on those for which provable bounds are shown. Place emphasis on development of innovative mathematical and numerical algorithms that enhance modeling and simulation capabilities in understanding and forecasting of complex physical phenomena and design and control of systems of interest to the Air Force. The application areas of interest include non-equilibrium plasma, non-steady aerodynamics for various flight regimes, material design, and structural mechanics. Focus on numerical algorithms that include multi-scale and multi-physics approaches with particular emphasis on convergence, error analysis and adaptability. Increase emphasis on development of algorithms for efficient and robust multidisciplinary design and optimization as well as understanding and quantifying the effects of uncertainties in computational models.					
CONGRESSIONAL ADD: Process Integrated Mechanism for Human-Computer Collaboration and Coordination. In FY 2008: Developed a novel technology of a process integrated mechanism, which ties together computers and humans into a single collaborating system by virtue of a single program that rapidly moves between all the computers in the system. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.948	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602201F/ Aerospace Flight Dynamics.	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Technology.	0.000	0.000							Continuing	Continuing
PE 0602602F/ Conventional Munitions.	0.000	0.000							Continuing	Continuing
PE 0602702F/ Command, Control, and Communications.	0.000	0.000							Continuing	Continuing
PE 0603789F/ C3I Advanced Development.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences					PROJECT NUMBER 612305	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
612305: Electronics	31.489	39.179	40.568						Continuing	Continuing

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 life cycle costs.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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 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. In FY 2008: Investigated 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 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. Investigated 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 novelheteromaterial interfacing and interconnect schemes, and biologically-based detection processes.	7.437	9.366	9.821	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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 nano-science 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. In FY 2010: Investigate novel methods for achieving integrated multi-mode electromagnetic spectra detection utilizing spatial, spectral, polarimetric, radiometric, phase, and temporal imaging and non-imaging detection and discrimination techniques, to include adaptive reconfigurable 'pixel' and/or detector element approaches spanning multiple-modes, and in one or more ultraviolet-infrared bands; biologically inspired detection processes and concepts will also be considered. Possible novel detector structures will include, but not limited to, integrated monolithic and/or hybrid approaches utilizing homogeneous and/or heterogeneous semiconductor and oxide material structures, potentially enabled by 0D, 1D, and/or 2D quantum-based structures. Additionally, bulk and nano-structure based electronic defect engineering physics will be studied to determine opportunities for modifying electronic band structure that critically affects photon absorption and carrier transport properties.					
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 battle space. In FY 2008: Continued to investigate nonlinear optical and laser materials, devices, and fabrication processes for radiation protection, cloaking and tracking, and target signature identification. Continued to explore nanoelectronics, nanophotonics, spintronics and other advanced optoelectronic and electronic materials and devices for lower power consumption, high-efficiency wavelength-diverse lasers, and high-sensitivity detectors. Furthered the examination of advanced optical memory technologies for enhanced data storage, including		13.608	15.717	15.968	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
negative index of refraction metastructures. Investigated technologies for 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. 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 wavelength-diverse lasers, and 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 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. In FY 2010: Further support research activities to better understand the fundamental nature of multi-ferroic alloys and composite materials for potential applicability to spin-gain devices, dynamic magnetic field detection for RF and microwave applications, and very high efficiency and compact piezoelectric AC to AC and DC to DC transformers. Continue to investigate meta-materials, phase-change and state-change semiconducting and dielectric materials for exploitation in reconfigurable logic, memory, and dynamic analog devices and systems. Further investigate silicon photonics as a mechanism for all optical fiber device signal and power interconnect. Further support research activities in the development of interconnectable photonic crystal modules so that integrated, all-optical photonic crystal logic and control systems can be subsequently developed as a transition from basic research.				
MAJOR THRUST: Exploit advances in nanotechnology to support multi-spectral detection technology, chip-scale optical networks, and compact power.	5.023	6.839	7.161	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences			PROJECT NUMBER 612305	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Further developed and refined techniques to control growth of self-assembled quantum structures and connections to these structures for multi-spectral image processing. Tested functionalities of structural materials and improved growth methods. Continued 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. Continued exploring nanophotonic concepts for information processing components and systems. 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. In FY 2010: Develop revolutionary infrared sensors with new functionality that would greatly limit the complexity, cost, and size of conventional imaging systems. Create mid-infrared detectors with nanoscale-patterned metallic photonic crystal structures supporting frequency-specific optical resonances that achieve dramatic improvement in the conversion efficiency of detectors. Investigate the fundamental science, materials, processes, and novel device architectures for surface plasmon-based, CMOS-compatible, optical elements, with focus on ultracompact, robust, and highly efficient photonic networks that are optimally suited for insertion into mobile military platforms. Exploit nanoscience to further understand and improve solar cells, fuel cells, thermoelectrics, and supercapacitors, by examining approaches such as quantum dots, nanowires, nanocrystals, nanotubes, nanomembranes, and non-traditional materials.					
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.		5.421	7.257	7.618	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Recent success in increasing current-carrying properties of high-temperature superconducting short sections of tape was exploited to increase those properties in longer lengths and attempts were made to reduce eddy-current loses. Microwave properties of high-temperature superconductors were given added emphasis because of recent progress in reducing losses at high frequencies. The goal was to provide thin-film superconducting material that could provide improved radar systems and compact communications systems. The search for practical even higher-temperature superconductors was continued. Efforts to create true 3-D negative index material at frequencies from microwave to infrared and visible were augmented. The search for higher-temperature, high-energy-product magnetic materials was continued using innovative nanomaterial technology. Using carbon nanotubes and other nanomaterials, new compact architectures were created to further miniaturize devices for signal processing, memory storage, and sensing. 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. In FY 2010: The coordinated program to discover more useful, more economical superconductors for power and electronic applications will have been put in place, and progress toward identifying promising materials will set in motion new efforts in physics, chemistry and materials science. New concepts in superconducting electronics will be tested using both magnesium diboride and yttrium-barium-copper-oxide superconducting films. Research will continue to find routes to make nanoscale ordered structures that will open the use of metamaterials to the optical and infrared part of the electromagnetic spectrum. At microwave frequencies metamaterials will be formed to produce sub-wavelength imaging. Demonstration of denser memory elements will be accomplished using crossbar architecture in contact with standard CMOS circuitry.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0602702F/ Command, Control, and Communications.	0.000	0.000							Continuing	Continuing
PE 0603203F/ Advanced Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603789F/ C3I Advanced Development.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
612306: Materials	36.069	25.609	29.442						Continuing	Continuing

Note

Note: In FY 2010, Natural Materials and Systems efforts from Project 2312 in this PE moved to this Project to more accurately align basic research efforts in Materials.

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 aerospace materials, and further increase thrust-to-weight ratio of engines. A primary research focus is on refractory alloys, intermetallics, polymer composites, metal and ceramic matrix composites, advanced ceramics, and new material processing methods. Basic research is also conducted in natural materials and systems to exploit unique properties and products for use in the development of advanced weapon technologies. Research is conducted to mimic the natural detection systems of organisms at the molecular level for use in developing novel man-made sensors. Research in natural materials focuses on using existing organisms or bioengineered organisms to manufacture new materials, or using the organisms themselves as materials. The primary areas investigated by this project are ceramics, non-metallic hybrid composites, metallic materials, and natural materials and systems.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Continued to optimize the design of multi-functional structural ceramic materials to enable structurally enhanced smart systems for application in extreme environments. Exploited new approaches in improving the thermal and mechanical stability of oxide ceramic composites for aircraft and engine applications. Further developed high-temperature resistant and joining methodologies for lightweight ceramic materials. Continued to develop innovative concepts for developing higher temperature and more damage-tolerant	9.135	12.351	12.255	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
organic, inorganic, and polymer matrix composites. Continued to exploit the use of nanomaterials and nanocomposites in aerospace structures. In FY 2009: Continue optimizing the design of multi-functional structural ceramic 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 ceramic and metallic composites for aerospace applications. Explore the role of the operational environment on the mechanisms of failure in hybrid materials. Expand the development of innovative concepts for developing higher temperature and more damage-tolerant organic, inorganic, and polymer matrix composites. Continue to exploit the use of nanomaterials and nanocomposites in aerospace structures. In FY 2010: Explore the connectivity of molecular scale modeling and micromechanics modeling to link the influence of constituents' properties to properties of fiber reinforced composites, ceramic matrix composites, and metallic composites. Interfacial properties of hybrid materials will be explored and their influence on component durability will be investigated. Damage initiation due to oxidation of high temperature polymer matrix composites will be modeled.					
MAJOR THRUST: Research metallic materials and identify relationships between structures including microstructures, processing, properties, and performance to develop durable metallic systems for advanced engines and aerospace structural applications. In FY 2008: Continued investigating metallic materials for sustainable use in structural applications and advanced engines. Investigated nano-laminates and nano-composites for aerospace armor and small air-vehicle structures. Explored the interaction between chemistry and mechanics in surfaces and interfaces of these nanoscale structures. Explored the processing and development of multifunctional structural metals for power systems and space applications. Capitalized on advances in multi-scale modeling to study the response of aerospace alloys exposed to corrosive environments and cyclical loading. Developed an informatics process exploiting disparate sources of materials' properties data derived from modeling and experimentation. Explored the fundamental science of friction and thermal effects during friction stir processing.		10.078	13.258	12.704	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Continue to 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. Study development and verify multi-scale 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. In FY 2010: Expand the investigation of complex laminates for aerospace materials to include understanding of failure mechanisms within these novel systems. Expand the development and verification of multi-scale equilibrium models to study the response of the material in a non-equilibrium environment. Refine the development of the informatics tools to accelerate the discovery of novel materials. Evolve the research on the fundamental science of friction and thermal effects during friction stir processing to focus on the role of the interface within metallic composites. Explore novel and alternative mechanisms to rapidly accelerate the processing and certification of advanced high temperature aerospace materials.					
MAJOR THRUST: Explore mimetics, natural materials, and natural/synthetic interfaces 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 physical mechanisms in nature will look to discover and understand basic natural mechanisms that could be used to either harden or repair natural materials-based devices and systems. Note: In FY 2010, these efforts moved to this Project from Project 2312 in this PE to more accurately align basic research efforts in Materials. In FY 2008: Not Applicable.		0.000	0.000	4.483	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences			PROJECT NUMBER 612306	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Not Applicable. In FY 2010: Continue manipulating materials to mimic the properties found in autonomous materials for sensing, maintenance, self-healing, and repair. Expand investigating predator avoidance and new prey detection schemes as future technology areas. Further probe and manipulate chromophores and photoluminescent characteristics in natural systems for applications to military sensor systems. Continue to exploit natural materials and natural/synthetic interfaces to: 1) control natural systems, 2) synthesize novel materials, 3) evaluate sensors, and 4) elucidate nanotechnology applications. Research natural materials' extension into new electronic and photonic systems by utilizing the self-assembly of these materials into unique electronic and optical architectures for ISR applications. Investigate natural systems in order to develop new synthetic avenues to produce unique material properties and systems. Continue investigations in extremophile research to access synthetic pathways and materials not achievable under standard conditions. Continue work in physical mechanisms in nature to discover and understand the basic underlying natural mechanism that could be used to either harden or repair natural materials-based devices.					
CONGRESSIONAL ADD: National Aerospace Leadership Initiative. In FY 2008: Continued to support aerospace R&D, fortify US-based manufacturing supply chain, and strengthen aerospace equipment manufacturers' R&D. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		15.323	0.000	0.000	
CONGRESSIONAL ADD: Hybrid Materials for Thermal Management in Thin Films and Bulk Composites. In FY 2008: Conducted research to develop advanced aeronautical structural members, sheathing, and coatings having longer service life.		1.533	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Not Applicable. In FY 2010: Not Applicable.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0602201F/ Aerospace Flight Dynamics.	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Technology.	0.000	0.000							Continuing	Continuing
PE 0602601F/ Space Technology.	0.000	0.000							Continuing	Continuing
PE 0603211F/ Aerospace Structures.	0.000	0.000							Continuing	Continuing
PE 0708011F/ Industrial Preparedness.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences					PROJECT NUMBER 612307	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
612307: Fluid Mechanics	13.652	20.429	24.213						Continuing	Continuing

Note

Note: In FY 2010, Natural Flight Control and Navigation efforts from Project 2313 in this PE moved to this Project to more accurately align basic research efforts in Fluid Mechanics.

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. Vehicle control principles based upon natural flight sensory and sensorimotor systems applicable to small unattended aerial vehicles (UAVs) and ultraslow flight are also examined. 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.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2008: Characterized and modeled fundamental phenomena of 3-D high-speed boundary layers to facilitate prediction and control of laminar-turbulent transition and the onset of severe heating rates in high-speed systems. Extended applicability and capability to handle complex flows of high-fidelity, unsteady numerical models for shock-dominated flows, and non-equilibrium effects. Continued development of control strategy models for mitigating excessive heat transfer and unsteadiness in hypersonic flows and for abating the effects of highly separated flows.	5.219	8.744	9.836	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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 non-equilibrium 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 vehicles. In FY 2010: Characterize and model fundamental phenomena of high-speed boundary laminar-turbulent transition to include interactions between multiple instability modes and realistic surface conditions including roughness. Validate high-fidelity, unsteady numerical simulation methodologies for shock-dominated flows including non-equilibrium effects, laminar-turbulent transition and automated grid refinement. Continue exploration of strategies for control of excessive heat transfer, unsteadiness, and separation in hypersonic flows to reduce severe local loads on systems. Characterize and model interactions between severe phenomena in aerothermodynamic environment and high-temperature vehicle materials with the goal of reducing thermal protection system complexity and increasing system performance.				
MAJOR THRUST: Expand fundamental knowledge of unsteady flows in integrated theoretical, experimental, and computational efforts. Study complex flow phenomena related to unsteady phenomena and coupled fluid-structure interactions with an emphasis on flow control approaches. In FY 2008: Further developed reduced order, closed-loop flow control mechanisms on unsteady flows of complex geometries and jet engines. Investigated new applications of flow control techniques to improve jet engine integration and efficiency for a wider range of flight operating conditions. Developed tools for predicting and controlling unsteady, vortex-dominated flows on UAVs. Explored and developed innovative techniques for improving convective heat transfer at all flow scales to enhance thermal management of subsonic and supersonic flight systems.	6.167	9.685	10.689	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2010: Explore reduced order, closed-loop flow control mechanisms on unsteady flows of complex geometries and flexible structures and identify canonical problems. Characterize and model promising applications of flow control techniques to optimize fluid-structure interactions and aerodynamic efficiency for a wider range of flight operating conditions. Validate tools for predicting and controlling unsteady, vortex-dominated flows on UAVs. Explore scientific issues related to multidisciplinary simulation of unsteady fluid-structure interactions.				
MAJOR THRUST: Research novel sensing and control mechanisms applicable to small UAVs and low Reynolds Number flight regimes. Expand fundamental knowledge of natural flight control and navigation mechanisms for which analogues do not yet exist in conventional engineered flight. Note: In FY 2010, these efforts moved to this Project from Project 2313 in this PE to more accurately align basic research efforts in Fluid Mechanics. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Characterize and model sensor-effector systems for natural flight control, target pursuit, and spatial navigation, with emphasis on robust agility at low Reynolds Numbers. Study sensory information processing mechanisms, including multi-modal sensing, to understand autonomous spatial orientation and optimal flight path guidance. Characterize closed-loop control mechanisms to optimize performance capabilities of flexible airfoils, e.g., with respect to sensing and handling of airflow disturbances, Coriolis forces, and wing loading.	0.000	0.000	3.688	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Develop and test neuromorphic emulations to enable adoption in engineered technology for autonomous or semi-autonomous air vehicles.				
CONGRESSIONAL ADD: Development and Validation of Advanced Design Technologies for Hypersonic Research (National Hypersonic Research Center). In FY 2008: Continued research on experimental and numerical simulation to characterize and develop predictive numerical methods for physical phenomena associated with hypersonics. In FY 2009: Continue research on numerical simulation to characterize and develop predictive methods for physical phenomena associated with hypersonics. In FY 2010: Not Applicable.	2.266	2.000	0.000	

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0602201F/ Aerospace Flight Dynamics.	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0603211F/ Aerospace Structures.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 612307

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences					PROJECT NUMBER 612308	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
612308: Propulsion	20.145	26.159	31.447						Continuing	Continuing

Note

Note: In FY 2010, Bioenergy and Catalysis efforts from Project 2312 in this PE moved to this Project to more accurately align basic research efforts in Propulsion.

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. As a newly emerging research direction within this project, bioenergy and catalysis will investigate the economical production of renewable biofuels for airbreathing engines and will explore biocatalysis for compact power applications.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Research and model space propulsion and power in the areas of chemistry, electronics, miniaturization, and contamination/signature. In FY 2008: Conducted studies of small satellite, microsatellite, and nanosatellite propulsion and investigated plasma dynamics in these thrusters. Evaluated methods to predict and suppress combustion instabilities under supercritical conditions, and developed research models that can be incorporated into the design codes. Developed novel diagnostic techniques for characterization of combustion instabilities in high pressure, harsh, optically thick environments. Continued to investigate high altitude plumes signature and contamination. Investigated alternate launch systems using electromagnetic forces as a rail-gun or coil-gun. Conducted 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.	8.627	11.695	11.809	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. 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. In FY 2010: Continue to research high altitude plume signature and contamination, including ice formation and optical scattering in geosynchronous orbits. Continue investigating alternate launch systems using electromagnetic forces and beamed energy. Investigate electrothermal materials in plasma propulsion to achieve regenerative power, thereby resulting in higher efficiencies and lower waste heat in satellites. Investigate novel energetic propellants for space propulsion to achieve cryogenic propellant performance with non-cryogenic systems. Introduce nano-energetics in liquid or gel propellants to increase specific impulse in liquid propulsion systems, and investigate various spray techniques for these novel propellant systems. Further enhance novel diagnostic techniques for characterization of combustion instabilities in high pressure, harsh, optically thick environments.				
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. Note: Starting in FY 2008, conduct basic research in support of a higher Air Force priority Energy Conservation -Assured Fuels Initiative to identify and develop technologies that enable the use of domestic fuel sources for military energy needs. In FY 2008: Continue improving laser diagnostic measurement capabilities, investigations of molecular transport effects causing and enhancing thermal destabilization of hydrocarbon fuels under supercritical	10.571	13.664	14.375	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
thermodynamic conditions, and prediction methodologies, which were both quantitatively accurate and computationally tractable, for turbulent combustion models. Further enhanced scientific bases for how plasmas were used to improve aerodynamic characteristics and propulsive efficiencies. Expanded strategies for using alternate hydrocarbon fuels based on the incorporation of detailed chemistry and transport models through surrogate fuel representations. Conducted research to provide fuel-flexible energy conversion technology in support of the Energy Conservation-Assured Fuels Initiative. 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. In support of the Energy Conservation-Assured Fuels Initiative, identify surrogate fuels that will represent the behavior of current and future alternative fuels through chemically simplified chemical compounds that retain the energy conversion characteristics of the base fuels. In FY 2010: 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. Initiate research on the coupling between plasma chemistry and fuel combustion chemistry to understand ignition and combustion enhancement by plasmas. Continue exploitation of strategies for using alternate hydrocarbon fuels by inserting reduced fuel representations into comprehensive combustion models such as large eddy simulations. In support of the Energy Conservation-Assured Fuels Initiative, initiate studies of novel propulsion system design based on alternative fuel properties to achieve optimization with respect to performance, environmental impact, cost, and assured supply.				
	0.000	0.000	5.263	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences			PROJECT NUMBER 612308	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Identify, characterize, and bioengineer photosynthetic and/or non-photosynthetic microorganisms for the macro-scale production of renewable jet and hydrogen fuels and for the micro-scale utilization of complex, impure biofuels in the delivery of compact power. Explore the basic mechanisms that control electron transfer reactions in biological catalysts, particularly at the biotic-abiotic interface. Note: In FY 2010, these efforts moved to this Project from Project 2312 in this PE to more accurately align basic research efforts in Propulsion. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Continue researching the biosolar generation of hydrogen by seeking to understand and manipulate the metabolic, genetic, and biophysical mechanisms utilized by some photosynthetic microbes (algae and cyanobacteria) in generating renewable hydrogen energy. Begin researching algal oil generation as a renewable jet fuel source by bio-prospecting for unique, oil-generating strains of algae whose genes may be used to enhance the production of algal oil. Continue research on biological fuel cells that explore the biophysical and catalytic mechanisms required for efficient electron transfer between electrodes and microbial materials, enabling the future utilization of complex, impure biofuels for compact power needs.					
CONGRESSIONAL ADD: Coal Transformation Laboratory. In FY 2008: Conducted research to produce domestic sources of biofuels and coal-based fuels. In FY 2009: Conduct basic research in the area of coal-to-liquids fuels, with focus on addressing the barriers that inhibit rapid commercialization of coal to liquid technologies. In FY 2010: Not Applicable.		0.947	0.800	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 612308

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Technology.	0.000	0.000							Continuing	Continuing
PE 0602601F/ Space Technology.	0.000	0.000							Continuing	Continuing
PE 0603211F/ Aerospace Structures.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences					PROJECT NUMBER 612311	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
612311: Information Sciences	24.081	31.551	46.436						Continuing	Continuing

Note

In FY 2010, efforts in building and testing mathematical descriptions of cognitive decision-making moved from Project 2313 in this PE to this Project to more accurately align basic research efforts in Information Services.

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 battle space 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 network, software, and system architectures; information fusion; information forensics; communications and signals and control of large systems. Information Sciences also derive mathematical models and computational algorithms designed to optimize information intelligently and problem-solving under adverse conditions, including sustained operations, non-cooperative environments, and multi-interactive command and control.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Explore basic mechanisms to realize gains in innovative transformational communications technologies, thereby enabling the AF to enhance its dominance communications using the space medium. Note: In FY 2010, this effort merged with the major thrust immediately following to more accurately align with other signal communications efforts. In FY 2008: Refined the details of the investigation that partially coherent laser beams are less disturbed by passage through turbulent atmospheres than their classically coherent counterparts. Pursued the design of solid state lasers which can emit such partially coherent beams. Continued to investigate the possibility that the long distance stability of polarization states can be exploited to communicate digitized messages.	0.948	1.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences			PROJECT NUMBER 612311	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Continue to study and refine results 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. In FY 2010: Not Applicable.					
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, asymptotic expansions, and transformational communications technologies. In FY 2008: Focused 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. Continued to study methodologies for evaluating the performance of new wireless mobile, networked communications systems. Continued study and assessment of technical alternatives for feasibility of super-resolution millimeter and search and rescue imagery. Continued 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. 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, 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. In FY 2010: Further study and refine results of selected solid state partially coherent laser designs together with the propagation of partially coherent laser beams through surrogate turbulent media. Move toward an evaluative assessment of practicality of free-space optical communication based on reduced or variable beam		5.127	7.055	6.488	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences			PROJECT NUMBER 612311	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
coherence. Conduct research in compressive sensing and image reconstruction to effect fusion of diverse sensors under multi-modal regime and data from sensor networks and countermeasures. Continue assessment of technical alternatives for feasibility of super-resolution millimeter and search and rescue imagery.					
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, and information fusion. In FY 2008: Significantly increased the investigation of first principles of software system, network, and information system architectures including characteristic properties and metrics, and began development of automatic software architecture analysis tools. Added research on brilliant software agents and other techniques for information operations, knowledge mining, and to improve situational awareness and command and control. Continued evolving information operations science techniques to exploit information intensive systems and networks. Further developed information fusion science to provide deep, adaptive, expert decision support. 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 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. In FY 2010: Focus studies on developing software-intensive systems that take into account the deep interaction between humans and computers. Begin information operations research on attack attribution and hardware/software interface security, and continue research on covert channel discovery. Develop fundamental mathematical methods for the description of local, global, and dynamic phenomena in networks		18.006	23.496	26.746	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences			PROJECT NUMBER 612311	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
and the assurance of the associated protocols. Develop techniques that enable integration of information and processes on networked systems in order to achieve high levels of situation awareness and response.					
MAJOR THRUST: Evaluate fundamental mechanisms and build mathematical descriptions of cognitive decision-making, including adaptation to non-cooperative interactions. Test mathematical models to predict and compensate for information-processing vulnerability. Conduct fundamental research on informational masking and signal intelligibility in communication networks. Note: In FY 2010, these efforts moved to this Project from Project 2313 in this PE to more accurately align basic research efforts in Information Sciences. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Investigate high-order cognitive processes critical for decision-making and problem-solving, with emphasis on the challenges of sustained operations in environments that require efficient operations under risk, uncertainty, high workload, and fatigue. Elucidate brain mechanisms that may inform computational approaches to information analysis, including mathematical representations of coupled neural oscillation, modulation filtering, and compressive sampling. Seek deeper scientific insight into principles of adaptive intelligence. Develop new approaches to optimize problem-solving in dynamic environments, with emphasis on decision strategies for adversarial, multi-dimensional, and multi-cultural conflict. Develop the basic research foundation, using computational and modeling approaches, to understand and anticipate competitive and cooperative interactions among decision-makers in a cross-cultural context.		0.000	0.000	13.202	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Technology.	0.000	0.000							Continuing	Continuing
PE 0602601F/ Space Technology.	0.000	0.000							Continuing	Continuing
PE 0602702F/ Command, Control, and Communications.	0.000	0.000							Continuing	Continuing
PE 0603410F/ Space System Environmental Interactions Technology.	0.000	0.000							Continuing	Continuing
PE 0603500F/ Multi-Disciplinary Advanced Development Space Technology.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences					PROJECT NUMBER 612312	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
612312: Biological Sciences	9.736	10.444	0.000						Continuing	Continuing

Note

Note: In FY 2010, efforts were moved from this Project to Projects 2306 and 2308 within this PE to more accurately align basic research efforts in the Materials and Propulsion disciplines, respectively.

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 utilize complex, impure biofuels for compact power.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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	5.499	5.877	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 612312

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
subsequent high-dose toxicity. Note: In FY 2010, efforts moved from this Project to Project 2308 within this PE to more accurately align basic research efforts in Propulsion. In FY 2008: Refined whole animal biokinetic models predicting tissue disposition of fuel components based on iterative experimental input derived from laboratory animal exposures and analyses. Began 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, began the molecular profiling and characterization of biological systems responding to high and low doses of directed energy generated from laser and microwave sources. Continued 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. Continued to utilize state-of-the-art tools and techniques to explore, collect, and analyze date with regard to low-dose chemical and radiation exposure effects and the molecular pathways and profiles mediating the responses to the exposures. 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 utilizing state-of-the-art tools and techniques to explore, collect, and analyze date with regard to low-dose chemical and radiation exposure effects and the molecular pathways and profiles mediating the responses to the exposures. In FY2010: Not Applicable.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 612312

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Note: In FY 2010, efforts moved from this Project to Project 2306 within this PE to more accurately align basic research efforts in Materials. In FY 2008: Initiated work on manipulating materials to mimic the desirable properties found in skin for maintenance, self-healing, and repair. Continued to investigate predator avoidance and new prey detection schemes as future technology areas. Further probed and manipulated biochromophores and biophotoluminescent characteristics in microbial and protein-based biosystems for applications to military sensor systems. Continued to exploit biomaterial and biointerfacial sciences to control cellular systems to synthesize novel materials, evaluate biosensors, and elucidate bionanotechnology applications. Researched surface mediated cellular differentiation as a new sensor modality. Continued investigations in extremophile research to access biosynthetic pathways and materials not achievable with room temperature organisms. Continued 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. In FY 2009: Continue work on manipulating materials to mimic the desireable properties found in skin for maintenance, self-healing, and repair. Expand investigating predator avoidance andnew 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 that could be used to either harden or repari bio-based devices or can utilize complex, impure biofuels for compact power.	4.237	4.567	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 612312

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Not Applicable.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0602602F/ Conventional Munitions.	0.000	0.000							Continuing	Continuing
PE 0602702F/ Command, Control, and Communication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences					PROJECT NUMBER 612313	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
612313: Human Performance	10.569	15.213	0.000						Continuing	Continuing

Note

Note: In FY 2010, efforts will move from this Project to Projects 2307 and 2311 within this PE to more accurately align basic research efforts in the Fluid Dynamics and Information Science disciplines, respectively.

A. Mission Description and Budget Item Justification

Human performance basic research seeks the fundamental knowledge needed to understand, measure, and optimize human capabilities critical to Air Force operations. Within this project, the special areas of scientific interest include Sensory Systems, Cognition and Decision, Homeostatic and Circadian Regulation of Human Performance, and Socio-Cultural Modeling. In all areas, experimental efforts are coordinated with mathematical or computational modeling. Air Force sensory research emphasizes human auditory capabilities, including 3D spatial hearing, multi-talker communication, speech intelligibility, and informational masking. Cognitive research emphasizes decision optimization in complex, dynamic tasks, including coordinated decision-making performed by networked, multi-person teams. Also aligned with Air Force cognitive research are efforts to determine how best to promote robust, reliable decision-making through information-processing algorithms for fusion, automation, and intelligent signal processing. Modeling efforts include cultural factors that may affect behavior in adversarial decision-making. The Air Force reliance on sustained human performance during trans-meridian operations and night operations motivates basic research efforts to predict and mitigate cognitive impairments from extended wake and much higher than normal workload periods.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. Note: In FY 2010, efforts moved from this Project to Project 2307 within this PE to more accurately align basic research efforts in Fluid Dynamics. In FY 2008: Continued empirical research with mathematical and computational modeling in spatial audition, speech perception, and hearing protection. Prepared new understanding of speech recognition and acoustic noise for transition to hearing protection technologies. Exploited multi-sensory integration methods and	5.132	6.468	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences			PROJECT NUMBER 612313	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
novel biological sensing mechanisms. Continued to probe biophysical mechanisms responsible for fatigue, including models of sleep/wake dynamics. Shifted emphasis from acute to chronic sleep deprivation in order to predict specific consequences in the performance of individual warfighters. Refined models showing effects of ultrashort laser pulse on the eye (laser flash blindness). In FY 2009: Engage new research methods to characterize requirements for optimal speech communication, including modulation representation and filtering. Develop data, models, and algorithms to minimize informational masking in speech signals and in spatial audio displays. To inform the design of new hearing protection systems, develop and test theoretical models for bone- and tissue-conducted cochlear excitation in high-noise environments. To improve the ability to understand and forecast cognitive impairments during continuous high workload conditions, employ new genomic and brain-monitoring methods to identify biomarkers for individual susceptibility. Devise new, physiologically accurate quantitative models to elucidate mechanisms of sleep/wake timing, homeostatic recovery, and re-entrainment to circadian phase shifts (e.g., "jet lag"). In FY 2010: Not Applicable.					
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. Note: In FY 2010, efforts will move from this Project to Project 2311 within this PE to more accurately align basic research efforts in Information Sciences. In FY 2008: Continued 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. Employed progress on modeling individual and team training for the development of training systems optimized for specific individuals, teams, and applications. Assessed mechanisms for continuous learning and automated, diagnostic mentoring of individuals to enable human and machine collaboration. Continued exploring measures		5.437	8.745	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 612313

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
to avert/mitigate human error and optimize decision making under conditions of uncertainty and information overload. Increased cognitive process modeling to include socio-cultural influences in competitive or non-cooperative environments for successful Airmen response to and prediction of adversary actions. In FY 2009: Specific research objectives include the development of mathematical and computational models to characterize important aspects of human cognitive performance in situations applicable to Air Force operational environments. The goal is to optimize human information-processing, problem-solving, and decision making, both for individual war fighters and for networked, collaborative teams. Research will probe human inference and reasoning under uncertainty, algorithms for information integration and fusion, and new approaches to ensure robust decision-making under continuous, extended duty and under rapidly changing, adversarial conditions. Continue to refine agent-based modeling and game theory, to include socio-cultural influences in competitive or non-cooperative environments for successful response to and prediction of adversary actions. New efforts will promote cross-disciplinary contributions from brain science, operations research, network theory, and computer science. In FY 2010: Not Applicable.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0602702F/ Command, Control, and Communication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 612313

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences					PROJECT NUMBER 614113	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
614113: External Research Programs Interface	10.782	9.807	9.741						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Continued to provide centralized cooperation expertise and support international technology liaison missions in order to identify and maintain awareness of foreign science and technology developments. Continued to capitalize on foreign investments by influencing and acquiring world-class scientific research. Continued to seek and maintain access to technical briefs and publications on unique foreign research capabilities. Continued to support international visits of high-level DoD delegations and provide primary interface to coordinate international participation among DoD organizations. Continued to assist in Air Force fiscal commitments to NATO-affiliated research institutes. 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.	4.302	5.407	5.319	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences			PROJECT NUMBER 614113	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Continue to seek and maintain access to technical briefs and publications on unique foreign 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. In FY 2010: 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 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.					
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. In FY 2008: Continued 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. Increased 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. 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. Note: $3.0M erroneously placed in this effort for Science Board support moved out of this program in FY 2009 and out.		6.480	4.400	4.422	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 614113

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: 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.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 614113

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0601103D/ University Research Initiative.	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0602201F/ Aerospace Flight Dynamics.	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Avionics.	0.000	0.000							Continuing	Continuing
PE 0602269F/ Hypersonic Technology Program.	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Technology.	0.000	0.000							Continuing	Continuing
PE 0602601F/ Space Technology.	0.000	0.000							Continuing	Continuing
PE 0602602F/ Conventional Munitions.	0.000	0.000							Continuing	Continuing
PE 0602702F/ Command, Control and Communication.	0.000	0.000							Continuing	Continuing

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601102F Defense Research Sciences	PROJECT NUMBER 614113

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research					R-1 ITEM NOMENCLATURE PE 0601103F University Research Initiatives					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	116.567	137.056	132.249						Continuing	Continuing
615094: University Research Initiatives	116.567	137.056	132.249						Continuing	Continuing

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. This program is in Budget Activity 1, Basic Science, because it funds scientific study and experimentation

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	119.938	125.949	130.938	
Current BES/President's Budget	116.567	137.056	132.249	
Total Adjustments	-3.371	11.107	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.373		
Total Congressional Increases	0.000	14.840		
Total Reprogrammings	0.000	-3.360		
SBIR/STTR Transfer	-3.371	0.000		

Change Summary Explanation

Note: In FY 2009, Congress added $1.6 million for Aerodynamic Wind Tunnel Upgrade, $1.28 million for Battle Space: Reducing Military Decision Cycles, $3.0 million for Cyber Security laboratory at Louisianna Tech University, $1.2 million for High Temperature Hydrogen Energy Production Facility, $0.8 million for Partnership in Innovative Preparation for Educators and Students (PIPES) and the Space Education Consortium (SEC), $1.6 million for Secure Grids for Network Centric Operations, $0.4 million for Unmanned aerial systems mission planning and operation center, $0.8M Rapid Prototyping and Nanotechology Initiative, $0.8M Lean Management Research Initiative at Air Mobility Wing MacDill AFB.

C. Performance Metrics

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601103F University Research Initiatives

(U) Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601103F University Research Initiatives					PROJECT NUMBER 615094	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
615094: University Research Initiatives	116.567	137.056	132.249						Continuing	Continuing

A. Mission Description and Budget Item Justification

N/A

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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, and high energy materials for propulsion and control. In FY 2008: 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 researchers in the early stages of their career through the Presidential Early Career Award for Scientists and Engineers (PECASE) program. Continued funding of multi-disciplinary programs initially awarded in prior years. 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. Support and recognize superior academic researchers in the early stages of their career through the PECASE program. Continue funding of multi-disciplinary programs initially awarded in prior years. In FY 2010: 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. Support and recognize superior academic researchers in the early stages of their career through the PECASE program. Continue funding of multi-disciplinary programs initially awarded in prior years.	54.117	71.312	73.338	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601103F University Research Initiatives			PROJECT NUMBER 615094	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2008: 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 (ASSURE) program. Continued funding for awards made under prior year Department of Defense programs. 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 ASSURE program. Continue funding for awards made under prior year Department of Defense programs. In FY 2010: Continue to award highly competitive NDSEG fellowships. Continue to support competitive awards for graduate and undergraduate research experiences including those established under the ASSURE program. Continue funding for awards made under prior year Department of Defense programs.		35.304	40.685	43.932	
MAJOR THRUST: Enhance the scientific and engineering research through advanced education infrastructure and instrumentation at U.S. universities. In FY 2008: 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 (DURIP). 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 DURIP.		11.309	13.579	14.979	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601103F University Research Initiatives			PROJECT NUMBER 615094	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: 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 DURIP.					
CONGRESSIONAL ADD: Partnership in Innovative Preparation for Educators and Students. In FY 2008: Conducted multi-disciplinary research associated with information network for educators and students. In FY 2009: Continue multi-disciplinary research associated with information network for educators and students. In FY 2010: Not Applicable.		1.544	0.800	0.000	
CONGRESSIONAL ADD: High Temperature Hydrogen Energy Production. In FY 2008: Conducted research to develop methods for hydrogen production. In FY 2009: Continue to conduct research to develop methods for hydrogen production. In FY 2010: Not Applicable.		0.965	1.200	0.000	
CONGRESSIONAL ADD: Battle Space Reducing Military Decision Cycles. In FY 2008: Developed decision making tool that can result in rapid and effective analyses of battlefield situational elements and recommendation for response.		2.318	1.280	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601103F University Research Initiatives			PROJECT NUMBER 615094	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009:Continued developing decision making tools that can result in rapid and effective analyses of battlefield situational elements and recommendation for response. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Frank R. Seaver Science and Engineering Complex. In FY 2008: Supported the Frank R. Seaver Science and Engineering Complex in conducting basic research in science and engineering disciplines. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.965	0.000	0.000	
CONGRESSIONAL ADD: Secure Grid Research. In FY 2008: Conducted research on the security issues in information technology architectures and components. In FY 2009: Continue to conduct research on the security issues in information technology architectures and components. In FY 2010: Not Applicable.		2.318	1.600	0.000	
CONGRESSIONAL ADD: University Research Initiatives.		7.727	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601103F University Research Initiatives			PROJECT NUMBER 615094	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Conducted university research and support post-graduate, graduate, and undergraduate education in science and engineering disciplines. In FY 2009: Not Applicable. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Aerodynamic Wind Tunnel Upgrade Initiative In FY 2008: Not Applicable. In FY 2009: Support major facility renovation and diagnostic capability acquisition for the University of Arizona Wind Tunnel. In FY 2010: Not Applicable.		0.000	1.600	0.000	
CONGRESSIONAL ADD: Cyber Security Laboratory at Louisiana Tech University FY 2008: Not Applicable. FY 2009: Focus on new and theoretically sound profiling techniques for detection and identification of terrorists and cyber attacks. FY 2010: Not Applicable.		0.000	3.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601103F University Research Initiatives			PROJECT NUMBER 615094	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Lean Management System Research Initaitive at Air Mobility Wing MacDill AFB FY 2008: Not Applicable. FY 2009:Facilitate civilian education and training program at the base. FY 2010: Not Applicable.		0.000	0.800	0.000	
CONGRESSIONAL ADD: Rapid Prototyping and Nanotechnology Initiative FY 2008: Not Applicable. FY 2009: Conduct rapid prototyping and automatic construction of physical objects with 3D printers, stereolithography machines or special laser sintering systems FY 2010: Not Applicable.		0.000	0.800	0.000	
CONGRESSIONAL ADD: Unmanned Aerial Systems Mission Planning and Operation Center FY 2008: Not Applicable. FY 2009: The Unmanned Aerial Systems (UAS) Mission Planning and Operation Center will work with the Great Plains Joint Regional Training Center to train Guard personnel in mission planning and aircraft operation using the CQ-10 Snowgoose UAS platform owned by the Guard for homeland security and disaster missions. FY 2010: Not Applicable.		0.000	0.400	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601103F University Research Initiatives	PROJECT NUMBER 615094

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0601102F/ Defense Research Sciences.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research					R-1 ITEM NOMENCLATURE PE 0601108F High Energy Laser Research Initiatives					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	12.221	13.389	12.834						Continuing	Continuing
615097: High Energy Laser Research Initiatves	12.221	13.389	12.834						Continuing	Continuing

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. The HEL Joint Technology Office (JTO) sends these funds to multi-disciplinary research institutes (MRIs) for projects on laser and beam control technologies. In addition, funding supports educational grants which are designed to stimulate interest in HELs. These educational grants are used for educational tools, scholarships, and summer intern employees in military laboratories. These funds are also used for modeling and simulation projects for the research of physics-based models of HEL systems. 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.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	12.556	13.425	13.030	
Current BES/President's Budget	12.221	13.389	12.834	
Total Adjustments	-0.335	-0.036	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.036		
Total Congressional Increases	0.000	0.000		
Total Reprogrammings	0.000	0.000		
SBIR/STTR Transfer	-0.335	0.000		

Change Summary Explanation

Not Applicable.

C. Performance Metrics

Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601108F High Energy Laser Research Initiatives					PROJECT NUMBER 615097	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
615097: High Energy Laser Research Initiatves	12.221	13.389	12.834						Continuing	Continuing

A. Mission Description and Budget Item Justification

N/A

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Improve the fundamental understanding of high-power laser sources, to include solid-state, free electron, and gas laser technologies. In FY 2008: Conducted fiber laser research focused on single aperture scaling single-mode fibers and organization of multiple fibers. Conducted fundamental research of optically-pumped atomic and molecular gas lasers. Initiated efforts in the solid state laser field including the development of an optically-pumped semiconductor laser and a new approach for high power eye-safe lasers. Initiated efforts in free electron laser research exploring robust photocathode technology and high brightness cathodes and their relationship to high-power free electron lasers. Investigated diode pumped alkali lasers operating at very high intensities. In FY 2009: Complete efforts to conduct fiber laser research focused on single aperture scaling single-mode fibers, and organization of multiple fibers. Complete fundamental research of optically-pumped atomic and molecular gas lasers. Continue research on awarded topics in diode-pumped alkali, free electron, and solid state laser technologies. Initiate interaction to look at promising technology development overseas. In FY 2010: Continue research on awarded topics in diode-pumped alkali, free electron, and solid state laser technologies. Initiate a new call for fiber-based solid state laser technologies. Establish overseas efforts to leverage international technology advancements.	7.341	8.244	8.677	
	2.580	2.545	3.418	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601108F High Energy Laser Research Initiatives			PROJECT NUMBER 615097	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2008: Completed negative thermal expansion research. Initiated efforts to mitigate aero-optic effects in order to enhance tactical HEL architectures and to reduce weight, size and complexity of the beam control systems while maximizing performance. In FY 2009: Continue mitigation of aero-optic effects to enhance tactical HEL architectures and to reduce weight, size and complexity of the beam control system. Establish overseas efforts to leverage international technology advancements. In FY 2010: Continue mitigation of aero-optic effects to enhance tactical HEL architectures and to reduce weight, size, and complexity of the beam control system. Establish overseas efforts to leverage international technology advancements.					
MAJOR THRUST: Maintain and evaluate high-fidelity models for incorporation into HEL systems scenario evaluations and the HEL toolkit. Provide for HEL systems level modeling into mission-level wargaming activities. Note: In FY 2010, modeling and simulation efforts transition to PE 0602890F, High Energy Laser Research. In FY 2008: Merged the developed models into a common architecture through verification and validation techniques. Conducted mission-level HEL engagement scenarios. In FY 2009: Initiate development of a solid state laser model to allow parameterization of components with the laser system. Develop a high-fidelity model for HEL system scenario evaluation. In FY 2010: Not Applicable.		1.650	1.850	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601108F High Energy Laser Research Initiatives	PROJECT NUMBER 615097

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Fund educational grants, through the Directed Energy Professional Society, intended to simulate interest in HEL technologies among students. In FY 2008: Provided scholarships and internships to support college students studying HEL degrees. Provided grants to Service Academies to stimulate HEL studies among military cadets. 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. In FY 2009: Provide scholarships and internships to support college students studying 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. Conduct a proposal call for FY 2010 for execution and coordination of the Educational Grant program. In FY 2010: Provide scholarships and internships to support college students studying 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.	0.650	0.750	0.739	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601108F High Energy Laser Research Initiatives	PROJECT NUMBER 615097

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0602890F/ High Energy Laser Research.	0.000	0.000							Continuing	Continuing
PE 0603444F/ Maui Space Surveillance System.	0.000	0.000							Continuing	Continuing
PE 0603605F/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0603924F/ High Energy Laser Advanced Technology Program.	0.000	0.000							Continuing	Continuing
PE 0602605F/ Directed Energy Technology.	0.000	0.000							Continuing	Continuing
PE 0602120A/ Sensors and Electronic Survivability.	0.000	0.000							Continuing	Continuing
PE 0602307A/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0602624A/ Weapons and Munitions Technology.	0.000	0.000							Continuing	Continuing
PE 0603004A/ Weapons and Munitions Advanced Technology.	0.000	0.000							Continuing	Continuing
PE 0602114N/ Power Projection Applied Research.	0.000	0.000							Continuing	Continuing
PE 0602702E/ Tactical Technology.	0.000	0.000							Continuing	Continuing
	0.000	0.000							Continuing	Continuing

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification				DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 1 - Basic Research			R-1 ITEM NOMENCLATURE PE 0601108F High Energy Laser Research Initiatives	PROJECT NUMBER 615097	
PE 0603175C/ Ballistic Missile Defense Technology.					
PE 0603883C/ Ballistic Missile Defense Boost Phase Segment.	0.000	0.000		Continuing	Continuing
PE 0602651M/ Joint Non-Lethal Weapons Applied Research.	0.000	0.000		Continuing	Continuing
PE 0603651M/ Joint Non-Lethal Weapons Technology Development.	0.000	0.000		Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance process to harmonize efforts and eliminate du	0.000	0.000		Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602015F Medical Development					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	1.490	4.887	0.000						Continuing	Continuing
625244: Diabetes Research	1.490	4.887	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

Funds for the FY 2008 Congressionally-directed Comprehensive Clinical Phenotyping and Genetic Mapping for the Discovery of Autism Susceptability Gene in the amount of $1.5 million and the FY 2009 Congressionally-directed Biothreat Test Pouch for Film Array System in the amount of $0.8 million, Health Surveillance System in the amount of $1.6 million, and Regional Telepathology Initiative at Keesler AFB in the amount of $2.5 million are in the process of being moved to the Defense Health Program from PE 0602015F, Medical Development, for execution. 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. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	4.670	0.000	0.000	
Current BES/President's Budget	1.490	4.887	0.000	
Total Adjustments	-3.180	4.887	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.013		
Total Congressional Increases	0.000	4.900		
Total Reprogrammings	-3.180	0.000		
SBIR/STTR Transfer	0.000	0.000		

Change Summary Explanation

In FY 2009, Congress added $0.8 million for Biothreat Test Pouch for Film Array System, $1.6 million for Health Surveillance System, and $2.5 million for Regional Telepathology Initiative at Keesler AFB. Note: Funds for the FY 2008 Congressionally-directed Comprehensive Clinical Phenotyping and Genetic Mapping for the Discovery of Autism Susceptability Gene in the amount of $1.5 million and the FY 2009 Congressionally-directed Biothreat Test Pouch for Film Array System in the amount of $0.8 million, Health Surveillance System in the amount of $1.6 million, and Regional Telepathology Initiative at Keesler AFB in the amount of $2.5 million are in the process of being moved to the Defense Health Program from PE 0602015F, Medical Development, for execution.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602015F Medical Development

C. Performance Metrics
Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602015F Medical Development					PROJECT NUMBER 625244	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
625244: Diabetes Research	1.490	4.887	0.000						Continuing	Continuing

Note

Note: Funds for the FY 2008 Congressionally-directed Comprehensive Clinical Phenotyping and Genetic Mapping for the Discovery of Autism Susceptability Gene in the amount of $1.5 million and the FY 2009 Congressionally-directed Biothreat Test Pouch for Film Array System in the amount of $0.8 million, Health Surveillance System in the amount of $1.6 million, and Regional Telepathology Initiative at Keesler AFB in the amount of $2.5 million are in the process of being moved to the Defense Health Program from PE 0602015F, Medical Development, for execution.

A. Mission Description and Budget Item Justification

N/A

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: Comprehensive Clinical Phenotyping and Genetic Mapping for the Discovery of Autism Susceptability Gene. In FY 2008: Conducted Congressionally-directed effort for Comprehensive Clinical Phenotyping and Genetic Mapping for the Discovery of Autism Susceptability Gene. In FY 2009: Not Applicable. In FY 2010: Not Applicable. In FY 2011: Not Applicable.	1.490	0.000	0.000	
CONGRESSIONAL ADD: Biothreat Test Pouch for Film Array System. In FY 2008: Not Applicable.	0.000	0.798	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602015F Medical Development			PROJECT NUMBER 625244	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Conduct Congressionally-directed effort for Biothreat Test Pouch for Film Array System. In FY 2010: Not Applicable. In FY 2011: Not Applicable.					
CONGRESSIONAL ADD: Health Surveillance System. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Health Surveillance System. In FY 2010: Not Applicable. In FY 2011: Not Applicable.		0.000	1.596	0.000	
CONGRESSIONAL ADD: Regional Telepathology Initiative at Keesler AFB. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Regional Telepathology Initiative at Keesler AFB. In FY 2010: Not Applicable. In FY 2011: Not Applicable.		0.000	2.493	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602015F Medical Development	PROJECT NUMBER 625244

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602102F Materials					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	175.040	188.152	127.957						Continuing	Continuing
6201SP: Space Materials Development	36.012	28.963	0.000						Continuing	Continuing
624347: Materials for Structures, Propulsion, and Subsystems	65.942	83.446	82.625						Continuing	Continuing
624348: Materials for Electronics, Optics, and Survivability	26.068	35.703	27.087						Continuing	Continuing
624349: Materials Technology for Sustainment	28.912	29.223	14.312						Continuing	Continuing
624915: Deployed Air Base Technology	18.106	10.817	3.933						Continuing	Continuing

Note

Note: FY 2008 funding totals include $3.41 million in supplemental funding. In FY 2010 and out, funds from Project 01SP have been moved to Project 4347, Project 4348, and Project 4349 within this Program Element to more accurately align efforts.

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 five projects that develop: (1) the materials and processing technology base for spacecraft and launch systems; (2) structural, propulsion, and sub-systems materials and processes technologies; (3) electronic, optical, and survivability materials and processes technologies; (4) sustainment materials, processes technologies, and advanced non-destructive inspection methodologies; and (5) air base operations technologies including deployable base infrastructure, force protection, and fire fighting capabilities. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	179.516	117.143	127.504	
Current BES/President's Budget	175.040	188.152	127.957	
Total Adjustments	-4.476	71.009	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.511		
Total Congressional Increases	3.410	71.360		
Total Reprogrammings	-5.311	0.160		
SBIR/STTR Transfer	-2.575	0.000		

Change Summary Explanation

In FY 2009, Congress added $3.0 million for Accelerated Insertion of Advanced Materials and Certification for Military Aircraft Structure Material Substitution and Repair, $1.6 million for Advanced Aerospace Heat Exchangers, $2.4 million for Advanced Carbon Fiber Research and Test Initiative, $1.6 million for Advanced Thermal Control Coatings for Space Applications, $2.4 million for Carbon Non-Materials for Advanced Aerospace Applications, $4.0 million for Ceramic Matrix Composite Turbine Blade Demonstration, $1.12 million for FEL Capabilities for Aerospace Microfabrication, $1.6 million for Fire and Blast Resistant Materials for Force Protection, $1.6 million for Gallium Nitride RF Power Technology, $2.4 million for High Power Broadly Tunable Middle-Infrared Laser Sources, $2.4 million for Intelligent Manufacturing Initiative, $0.8 million for Large Area, APVT Materials Development for High Power Devices, $1.2 million for Light Weight Organic Photovoltaic Technologies, $1.6 million for Liquid Crystal Laser Eye Protection, $1.2 million for Nanocomposites for Lightning Protection of Composite Airframe Structures, $0.8 million for Optic Band Control Program, $1.6 million for Partnership for Emerging Technologies, $2.0 million for Pennsylvania NanoMaterials Commercialization Center, $2.8 million for Plasma-Sphere Array for Flexible Electronics, $1.6 million for Science for Sustainment, $4.0 million for Advanced Military Installations That Integrate Renewable Energy and Advanced Energy Storage Technologies, $8.0 million for Air Force Minority Leaders Program, $3.0 million for Aircraft Fatigue Modeling and Simulation, $1.44 million for Conducting Polymer Stress and Damage Sensors for Composites, $2.4 million for Consortium for Nanomaterials for Aerospace Commerce and Technology, $2.0 million for Diamond Substrate for Cooling of Micro-Electronics, $1.6 million for LGX High Temperature Acoustic Wave Sensors, $0.8 million for Mobile Wind Turbine Systems to Power Forward Bases, $4.0 million for ONAMI Safer Nanomaterials and Nanomanufacturing, $1.6 million for Tactical Shelters Next Generation Composite Initiative, $3.36 million for Institute for Science and Engineering Simulation (ISES), and $1.6 million for Innovative Polymeric Materials for Three-Dimensional (3-D) Microdevice Construction.

C. Performance Metrics
Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602102F Materials					PROJECT NUMBER 6201SP	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
6201SP: Space Materials Development	36.012	28.963	0.000						Continuing	Continuing

Note

Note: Funds from Project 01SP have been moved to Project 4347, Project 4348, and Project 4349 within this Program Element to more accurately align efforts.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop materials and processes to dramatically improve performance, durability, and cost of rocket propulsion systems. In FY 2008: Optimized 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. Developed processes to produce full scale test components that can be tested in rocket engine environment. Analyzed material behavior in rocket combustion environment. Constructed pervasive materials requirements to meet advanced performance and cost goals. Validated and demonstrated materials, test sub-elements, and sub-components for thrust chambers, nozzles, and catalysts. 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	4.400	3.241	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 6201SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. Optimize selected materials, test sub-elements, and sub-components for thrust chambers, nozzles, and catalysts. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop affordable, advanced structural and non-structural materials and processing technologies for Air Force space applications. In FY 2008: Developed and validated test methodology and evaluation techniques for processing, durability, and life prediction of thermal protection system applications for selected thin gage metallic materials. Developed scale-up processing and integration techniques that will provide the capability for fabrication of complex geometries and built-up structures. Explored materials options for high-temperature protection systems for expendable and reusable high-speed vehicle applications in collaboration with industry. Transitioned data on oxidation protection schemes for carbon-carbon materials. Demonstrated benefits of nano-tailored composite materials for multifunctional space applications. Validated wear-resistant materials, lubricants, and Micro-Electro-Mechanical System (MEMS) devices for moving mechanical assemblies on spacecraft against environment specific criteria. Evaluated candidate space materials and collected critical data to facilitate materials transition. In FY 2009: Optimize 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. Evaluate candidate space materials and collect critical data to facilitate materials transition.		18.701	14.739	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 6201SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
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. In FY 2008: Demonstrated processes and process control methodology to enable very long wavelength infrared detection. Developed 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). Developed nano-photonic materials for high performance optoelectronic devices for optical communications and system control architectures. Demonstrated materials and materials process technologies for application in combined optical and radio frequency communication system apertures. In FY 2009: Continue to demonstrate processes and process control methodology to enable very long wavelength infrared focal plane arrays. Demonstrate processing technology for short wavelength infrared detectors 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. In FY 2010: Not Applicable.		12.911	10.983	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials	PROJECT NUMBER 6201SP

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602102F Materials					PROJECT NUMBER 624347	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
624347: Materials for Structures, Propulsion, and Subsystems	65.942	83.446	82.625						Continuing	Continuing

Note

Note: Funds from Project 01SP have been moved to Project 4347 within this Program Element to more accurately align efforts.

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 and nonmetallic composites, and hybrid materials 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. Materials for thermal management including coolants, adaptive thermally conductive materials, coatings, friction and wear-resistant materials, and other pervasive nonstructural materials technologies are being developed for directed energy, propulsion, and subsystems on aircraft, spacecraft, and missiles. Develops nanostructured and biological materials for aircraft structures, munitions, air vehicle subsystems, and personnel. Develops novel materials for electromagnetic interactions with matter for electromagnetic pulse (EMP), high power microwave (HPM), and lightning strike protection. Concurrently develops advanced processing methods to enable adaptive processing of aerospace materials.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop ceramics, ceramic matrix composite, and hybrid materials technologies for revolutionary performance and supportability improvements in advanced propulsion systems and high temperature aerospace structures. Note: The increase in funding in FY 2010 and out is a result of funds being moved from Project 01SP to better align efforts. In FY 2008: Demonstrated advanced ceramic composite performance through testing under real and simulated engine service life conditions. Demonstrated environmental degradation analysis in the ceramic	2.700	2.389	11.340	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials		PROJECT NUMBER 624347

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
composite life prediction model. Validated the severe environment durability of advanced ceramic composite systems with advanced interfaces via mechanical testing. 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. In FY 2010: Complete validation of 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. Initiate development of new spacecraft catalyst bed systems. Assess performance of ultra high temperature ceramics (UHTC) leading edges in a relevant hypersonic environment (arc jet test rig) and validate oxidation models. Validate materials and materials process technologies for application in combined optical and radio frequency communication system apertures.				
MAJOR THRUST: Develop enabling nanostructured materials for diverse aerospace applications including enhanced aircraft canopies, electromagnetic hardening, air vehicle energy generation and storage devices, and improved low-observable platforms. Develop nanoscale architectures to address electromagnetic applications. Develop metamaterials with properties enabling compact sensors including conformal array antennas, low-electromagnetic interference (EMI) electronics, and optical elements based upon complex media. Note: In FY 2009 and out, this increase in funding is due to greater emphasis on metamaterials. In FY 2008: Delivered second-generation two photon absorbing (TPA) materials for night vision goggle evaluation. Transitioned photonic crystals for super prism applications. Transitioned aromatic hyperbranched polymers for structural component manufacture via resin transfer molding processes. Developed organic-inorganic metamaterials for Air Force electromagnetic and photonic applications for reduced aperture size, conformal radar, and antenna systems. Transitioned organic-inorganic nanostructured materials for lightning	5.384	13.200	19.193	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624347	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
strike resistant refueling boom. Developed EMI and high power microwave (HPM) shielding for electronics hardening. Developed adaptive (shape memory and actuator) materials based on polymer nanocomposites for adaptive aircraft structures, wings, fins, antennas, and mirrors. Developed lightweight, low-cost photovoltaics for uninhabited air vehicle applications. 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 HPM shielding for electronics hardening. Investigate and develop lightweight, conformal metamaterials with properties that will enable compact sensor applications including: conformal array antennas, low EMI electronics, and optical elements based upon complex media. Evaluate the properties of these materials and determine performance enhancement of fixed frequency metamaterial optical elements. Assess the viability of obtaining metamaterial properties consistent with the demonstration of highly integrated subsystems based on radio frequency integrated circuit applications to enable small, highly directional antenna element device drivers. In FY 2010: Explore material concepts for adaptive and multifunctional aircraft structures. Explore low-cost processing methodologies for photovoltaics for unmanned aerial systems (UAS) applications. Explore new materials systems and nano geometries to improve electrochemical energy storage including development of long-life electrodes. Investigate materials for high frequency passive microwave components for reduced size and lightweight application to air vehicles. Explore concepts for multifunctional and conformal radio frequency (RF) passive components for air vehicles. Explore metamaterials options for electro-optic/infrared (EO/IR) applications. Explore metamaterials for high frequency RF passive microwave applications.					
MAJOR THRUST: Develop affordable, lightweight metallic materials, behavior and life prediction technologies, higher temperature intermetallic alloys, and metals processing technologies to enable enhanced performance, lower acquisition costs, increased durability, and improved reliability for Air Force weapon systems. Note: The increase in funding in FY 2010 is related to an overlap of efforts that are completing with the initiation of follow-on efforts.		13.314	11.035	15.786	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials		PROJECT NUMBER 624347

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Developed materials-damage predictive approaches for engine health determination and life extension capability. Developed advanced metallic materials for enhanced performance propulsion for air platforms with an emphasis on higher temperature capability. Validated computational methods supporting development and processing to reduce costs to accelerate insertion of advanced metals into Air Force systems. 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. In FY 2010: Continue development and validation of advanced metallic materials and processes for enhanced performance propulsion for air platforms with an emphasis on higher temperature capability. Initiate development of an advanced disk system concept for insertion into advanced propulsion concepts for air platforms. Initiate development of advanced materials and processes for liquid rocket engine applications. Initiate development of advanced computation methods to support modeling of materials for advanced propulsion systems. Demonstrate processing for thin gage metallics and fabrication of honeycomb and sandwich panels. Validate panel analysis methodology. Develop quantitative models linking microstructure with thermal and physical properties of metallic thermal management materials.				
MAJOR THRUST: Develop affordable, advanced organic matrix composite structural materials, hybrid and/or multifunctional materials, and carbon-carbon composites 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: The increase in funding in FY 2010 and out is a result of funds being moved from Project 01SP to better align efforts. In FY 2008: Demonstrated life prediction tools for engine and airframe applications. Transitioned high temperature organic matrix composites. Downselected and optimized most promising new material systems	7.419	7.943	16.252	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624347	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
for space and high speed vehicle applications. Demonstrated the multifunctional payoffs of nanotailored composite materials for aerospace platform applications. Developed and demonstrated nanomaterials modeling and technology with an emphasis on accelerating the insertion and transition of this class of materials. Validated advanced composite material concepts and processes for specific weapon system needs. 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. Develop advanced material concepts and processes to address thermal management applications for weapon and air vehicle platforms. In FY 2010: Continue to demonstrate improved performance of new material systems for space and high-speed vehicle applications. Complete development of advanced material concepts and processes to address weapon and air vehicle platforms. Initiate investigation of new advanced composites systems for solid rocket motor cases. Explore composite and hybrid life prediction tools for engine and airframe applications. Explore lightweight, active, adaptive, high temperature, and durable composite and hybrid materials for engine and airframe applications. Demonstrate durable passive leading edge concepts for responsive access to space. Investigate advanced carbon fibers modified by carbon nanotubes. Explore novel high-performance coolants for directed energy and aircraft systems. Explore cost effective, high-conductivity, lightweight, phase change, thermal management and thermoelectric materials with adaptable, tunable heat transfer properties. Explore high-fidelity, multiscale predictive tools for thermal management across heterogeneous material systems and interfaces. Integrate ceramic and metallic thermal protection systems (TPS) subcomponents and evaluate in a relevant space vehicle environment.					
MAJOR THRUST: Develop nonstructural materials for fluids, lubricants, aircraft topcoat and corrosion resistant coatings, and specialty treatments to improve system performance and reduce life cycle costs. In FY 2008: Transitioned candidate gap treatment materials on low observable air vehicles. Demonstrated the analytical models that will be used to predict the optical properties of specialty coatings based on measured data. Transitioned the non-chromate surface treatments for aircraft corrosion protection systems. Validated		5.718	4.355	3.531	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624347	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
chrome-free primer for corrosion protection systems with a 30-year life expectancy. Demonstrated improved low friction wear, multifunctional coatings on engineering components. Developed and optimized surface treatment candidates for friction, stiction, and wear control in micro devices. 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. Continue to demonstrate improved low friction wear, multifunctional coatings on engineering components. Demonstrate surface treatment candidates for friction, stiction, and wear control in micro devices. In FY 2010: Initiate effort to develop combined thermal/friction coating materials for extreme environments. Develop alternative/renewable energy materials and technologies for Air Force deployed applications, including biomass and other alternative energy solutions.					
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. Develop science and technology for pervasive nanostructured and biological materials and device processing mechanisms for aircraft and space structures and sub-systems like actuators, sensors, and electronics. Note: The increase in funding in FY 2010 and out is a result of funds being moved from Project 01SP to better align efforts. In FY 2008: Investigated large-scale synthesis and characterization of energetic nanomaterials to provide stable, triggerable, nanoscale energetic materials for enhanced energy release munitions and access to space. Discovered and designed unconventional nanomaterial behavior with regard to energy release via robust modeling and simulation. Investigated the transport and compartmentalization of nanoparticles within the environment. Developed microstructural characterization tools to provide robust processing-performance correlations of nanoenergetic systems. Investigated 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.		5.161	5.271	14.523	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624347	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2010: Demonstrate large-scale synthesis and characterization techniques for energetic nanomaterials to provide stable, triggerable, nanoscale energetic materials for enhanced energy release munitions, high efficiency air-breathing propulsion, and access to space. Validate the transport and compartmentalization of nanoparticles being investigated as nanoenergetics to evaluate potential environmental impact. Analyze microstructural characterization tools to provide robust processing-performance correlations of nanoenergetic systems. Develop multi-component, structured nanoparticle catalyses as controlled release agents for enhancing stability and storage as well as providing enhanced ignition. Downselect most promising biological/ nanomaterial hybrids for the detection and identification of threat agents.					
MAJOR THRUST: Develop practical, affordable, and novel high temperature materials, structures, and thermal management concepts to enable future defense capabilities for prompt global strike concepts including advanced hypersonic weapons, high mach missiles, global strike missiles, hypervelocity flight vehicles and propulsion systems, and hypervelocity weapons. Note: The increase in funding in FY 2010 and out is a result of increased emphasis in high temperature materials. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		0.000	0.000	2.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624347	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Investigate advanced ceramics, ceramic matrix composites, hybrids, and metallic concepts for hot structure and thermal protection systems.					
CONGRESSIONAL ADD: Air Force Minority Leaders Program. In FY 2008: Conducted Congressionally-directed effort for Air Force Minority Leaders Program. In FY 2009: Conduct Congressionally-directed effort for Air Force Minority Leaders Program. In FY 2010: Not Applicable.		5.876	7.978	0.000	
CONGRESSIONAL ADD: Pennsylvania Nanomaterials Commercialization Center. In FY 2008: Conducted Congressionally-directed effort for Pennsylvania Nanomaterials Commercialization Center. In FY 2009: Conduct Congressionally-directed effort for Pennsylvania Nanomaterials Commercialization Center. In FY 2010: Not Applicable.		1.566	1.995	0.000	
CONGRESSIONAL ADD: Carbon Non-Materials for Advanced Aerospace Applications. In FY 2008: Conducted Congressionally-directed effort for Carbon Nano-Materials for Advanced Aerospace Applications, AQW Rice University.		1.566	2.393	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials	PROJECT NUMBER 624347

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Conduct Congressionally-directed effort for Carbon Non-Materials for Advanced Aerospace Applications. In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: Nanocomposites for Lightning Protection of Composite Airframe Structures. In FY 2008: Conducted Congressionally-directed effort for Nanocomposites for Lightning Protection of Composite Airframe Structures. In FY 2009: Conduct Congressionally-directed effort for Nanocomposites for Lightning Protection of Composite Airframe Structures. In FY 2010: Not Applicable.	1.566	1.197	0.000	
CONGRESSIONAL ADD: Nanotechnology Research. In FY 2008: Conducted Congressionally-directed effort for Nanotechnology Research. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	4.899	0.000	0.000	
CONGRESSIONAL ADD: ONAMI Safer Nanomaterials and Nanomanufacturing.	3.136	3.989	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624347	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Conducted Congressionally-directed effort for ONAMI Safer Nanomaterials and Nanomanufacturing. In FY 2009: Conduct Congressionally-directed effort for ONAMI Safer Nanomaterials and Nanomanufacturing. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Consortium for Nanomaterials for Aerospace Commerce and Technology (CONTACT). In FY 2008: Conducted Congressionally-directed effort for University of Houston CONTACT. In FY 2009: Conduct Congressionally-directed effort for CONTACT. In FY 2010: Not Applicable.		2.351	2.393	0.000	
CONGRESSIONAL ADD: Innovative Polymeric Materials for Three-Dimensional (3-D) Microdevice Construction. In FY 2008: Conducted Congressionally-directed effort for Innovative Polymeric Materials for 3-D Microdevice Construction. In FY 2009: Conduct Congressionally-directed effort for Innovative Polymeric Materials for 3-D Microdevice Construction. In FY 2010: Not Applicable.		0.979	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624347	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: High Temperature Aerogel Materials for Global Strike Vehicles. In FY 2008: Conducted Congressionally-directed effort for High Temperature Aerogel Materials for Global Strike Vehicles. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.566	0.000	0.000	
CONGRESSIONAL ADD: Durable Hybrid Coatings for Aircraft Systems. In FY 2008: Conducted Congressionally-directed effort for Durable Hybrid Coatings for Aircraft Systems. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.175	0.000	0.000	
CONGRESSIONAL ADD: Chrome Free Environmentally Friendly Corrosion Protection for Aircraft. In FY 2008: Conducted Congressionally-directed effort for Chrome Free Environmentally Friendly Corrosion Protection for Aircraft. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.566	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624347	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Advanced Aerospace Heat Exchangers. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Advanced Aerospace Heat Exchangers. In FY 2010: Not Applicable.		0.000	1.596	0.000	
CONGRESSIONAL ADD: Advanced Carbon Fiber Research and Test Initiative. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Advanced Carbon Fiber Research and Test Initiative. In FY 2010: Not Applicable.		0.000	2.393	0.000	
CONGRESSIONAL ADD: Advanced Thermal Control Coatings for Space Applications. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Advanced Thermal Control Coatings for Space Applications. In FY 2010: Not Applicable.		0.000	1.596	0.000	
CONGRESSIONAL ADD: Ceramic Matrix Composite Turbine Blade Demonstration.		0.000	3.989	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624347	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Ceramic Matrix Composite Turbine Blade Demonstration. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Institute for Science and Engineering Simulation (ISES). In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for ISES. In FY 2010: Not Applicable.		0.000	3.351	0.000	
CONGRESSIONAL ADD: Intelligent Manufacturing Initiative. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Intelligent Manufacturing Initiative. In FY 2010: Not Applicable.		0.000	2.393	0.000	
CONGRESSIONAL ADD: Mobile Wind Turbine Systems to Power Forward Bases.		0.000	0.798	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624347	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Mobile Wind Turbine Systems to Power Forward Bases. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Partnership for Emerging Technologies. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Partnership for Emerging Technologies. In FY 2010: Not Applicable.		0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603112F/ Advanced Materials for Weapon Systems.	0.000	0.000							Continuing	Continuing
PE 0603211F/ Aerospace Technology Dev/Demo.	0.000	0.000							Continuing	Continuing
PE 0603216F/ Aerospace Propulsion and Power Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602102F Materials					PROJECT NUMBER 624348	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
624348: Materials for Electronics, Optics, and Survivability	26.068	35.703	27.087						Continuing	Continuing

Note

Note: Funds from Project 01SP have been moved to Project 4348 within this Program Element to more accurately align efforts.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop, evaluate, and mature infrared (IR) detector materials, hybrid materials, and materials processing technologies to enable improved performance, affordability, and operational capability of Air Force surveillance, tracking, targeting, and situational awareness systems. Note: The increase in funding in FY 2010 and out is a result of funds being moved from Project 01SP to better align efforts. In FY 2008: Explored and validated suitable materials and structures for innovative IR materials in order to assess appropriateness for Air Force IR detection applications. Designed and demonstrated IR materials systems capable of responses to more than two discrete wavelengths. Assessed feasibility of further research and utility of three-dimensional material growth to exploit unique detection properties of complex IR materials. Developed promising materials growth technologies for nano-scale IR detection materials. Developed epitaxial materials and devices fabricated for high power applications. Investigated materials to enable development of design capabilities. Improved materials matching between device and substrates to enable higher power efficiency, better reliability, and increased power density to enable power dense devices.	1.437	1.917	8.348	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624348	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2010: Increase yield of full wafer focal plane arrays of 2k x 2k and develop multifunction readout integrated circuit. Investigate alternative IR materials for long wavelength detection. Pursue emerging IR materials in the short wave regime for day-night operation. Model and evaluate optical behavior of materials for low observable (LO), intelligence, surveillance, and reconnaissance (ISR), and other applications. Investigate materials constructs for multi-wavelength detection. Explore single material, multi-wavelength materials schemes. Extend capability of three-dimensional detection to multiple bands and explore tailoring options for diverse mission requirements. Advance and refine growth technology for nano-scale IR detection. Explore options for novel nano-scale detection.					
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 2010, funds from this effort break out into the fifth major thrust to separate distinct technology areas. In FY 2008: Demonstrated optimized nonlinear optical limiter materials for damage protection of eyes and sensor systems. Validated photorefractive materials properties for Air Force passive protection applications. Developed devices using switchable filter technology into eye and sensor system protection concepts. 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	8.118	9.522	5.969	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624348	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
applications. Demonstrate devices using switchable filter technology into eye and sensor system protection concepts. In FY 2010: Develop nonlinear optical limiter solid-state materials into device concepts for damage protection of space-based sensor systems. Investigate photorefractive materials growth repeatability for increased probability of technology transition to Air Force passive protection applications. Demonstrate electrically tunable liquid crystal filters for sensor system protection concepts. Develop thin film concepts for enhanced fixed filter performance. Develop and analyze electromagnetic interference (EMI) and high power microwave (HPM) shielding for electronics hardening.					
MAJOR THRUST: Develop and demonstrate materials and process technologies for power generation, power control, and microwave components to provide improved performance, affordability, and operational capability with reduced size, weight, and power for Air Force surveillance, tracking, targeting, situational awareness, and lethal and non-lethal weapon systems. Note: In FY 2010, funds were reduced to fund higher Air Force priorities. In FY 2008: Explored materials impact on device reliability for power control systems, advanced radar, and electronic countermeasures application. Demonstrated the capabilities of advanced materials process technologies and investigated 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. Demonstrated performance of candidate materials for use in terahertz components, supporting high speed communications and advanced sensors. 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.		6.875	8.281	5.355	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624348	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Explore and identify materials-to-materials interactions responsible for reduced reliability. Refine thin film growth process for improved wide bandgap semiconductor material. Investigate performance issues in materials components of high power microwave directed energy weapons. Develop nanostructured materials using multiple approaches for high energy density capacitors for pulsed power applications.					
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: Increase in funding in FY 2010 is due to increased emphasis on bio-taggants. In FY 2008: Investigated use of biological/nanomaterial-based taggants for the detection and identification of threat agents at a distance using hybrid constructs. Assessed effectiveness of threat agent destruction using taggants in counterproliferation operations. Neutralized biological and chemical agents with the inherent and supplementary properties of the taggant nanoparticles. Developed active and passive polymer encapsulation technologies for taggant materials. In FY 2009: Develop new biological/nanomaterial hybrids for the detection and identification of threat agents. Analyze efficacy data of using taggants for preemptive destruction of threat 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. In FY 2010: Validate efficacy data of using taggants for preemptive destruction of threat 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.		1.647	1.701	4.960	
MAJOR THRUST: Develop materials with properties enabling higher performance lasing media, new laser architectures, optical isolators, beam steering, and other high energy laser components for directed energy. Note: In FY 2010, this effort breaks out from the second major thrust to separate distinct technology areas.		0.000	0.000	2.455	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624348	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Investigate host/dopant materials for fiber lasers in the eye-safe regime. Demonstrate preliminary fiber development. Demonstrate solid state, very high speed beam steering materials options. Investigate very high speed beam steering configurations. Explore options and develop alternate materials and processes for high energy lasers.					
CONGRESSIONAL ADD: Advanced Engineered Non-Linear Optical Materials for Critical Wavelengths. In FY 2008: Conducted Congressionally-directed effort for Advanced Engineered Non-Linear Optical Materials for Critical Wavelengths. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.942	0.000	0.000	
CONGRESSIONAL ADD: Free Electron Laser Capabilities for Aerospace Microfabrication. In FY 2008: Conducted Congressionally-directed effort for Free Electron Laser Capabilities for Aerospace Microfabrication. In FY 2009: Conduct Congressionally-directed effort for Free Electron Laser Capabilities for Aerospace Microfabrication. In FY 2010: Not Applicable.		1.566	1.117	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624348	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Gallium Nitride (GaN) RF Power Technology. In FY 2008: Conducted Congressionally-directed effort for GaN RF Power Technology. In FY 2009: Conduct Congressionally-directed effort for GaN RF Power Technology. In FY 2010: Not Applicable.		1.566	1.596	0.000	
CONGRESSIONAL ADD: Large Area, APVT Materials Development for High Power Devices. In FY 2008: Conducted Congressionally-directed effort for Large Area, APVT Materials Development for High Power Devices. In FY 2009: Conduct Congressionally-directed effort for Large Area, APVT Materials Development for High Power Devices. In FY 2010: Not Applicable.		1.566	0.798	0.000	
CONGRESSIONAL ADD: Plasma-Sphere Array for Flexible Electronics. In FY 2008: Conducted Congressionally-directed effort for Plasma-Sphere Array for Flexible Electronics. In FY 2009: Conduct Congressionally-directed effort for Plasma-Sphere Array for Flexible Electronics. In FY 2010: Not Applicable.		1.566	2.792	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624348	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Polymer Nanocomposites for Energy Storage and Pulsed Power. In FY 2008: Conducted Congressionally-directed effort for Polymer Nanocomposites for Energy Storage and Pulsed Power. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.785	0.000	0.000	
CONGRESSIONAL ADD: Diamond Substrate for Cooling of Micro-Electronics. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Diamond Substrate for Cooling of Micro-Electronics. In FY 2010: Not Applicable.		0.000	1.995	0.000	
CONGRESSIONAL ADD: High Power Broadly Tunable Middle-Infrared Laser Sources. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for High Power Broadly Tunable Middle-Infrared Laser Sources. In FY 2010: Not Applicable.		0.000	2.393	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624348	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Light Weight Organic Photovoltaic Technologies. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Light Weight Organic Photovoltaic Technologies. In FY 2010: Not Applicable.		0.000	1.197	0.000	
CONGRESSIONAL ADD: Liquid Crystal Laser Eye Protection. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Liquid Crystal Laser Eye Protection. In FY 2010: Not Applicable.		0.000	1.596	0.000	
CONGRESSIONAL ADD: Optic Band Control Program. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Optic Band Control Program. In FY 2010: Not Applicable.		0.000	0.798	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials	PROJECT NUMBER 624348

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603112F/ Advanced Materials for Weapon Systems.	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603211F/ Aerospace Technology Dev/Demo.	0.000	0.000							Continuing	Continuing
PE 0603231F/ Crew Systems and Personnel Protection Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602102F Materials					PROJECT NUMBER 624349	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
624349: Materials Technology for Sustainment	28.912	29.223	14.312						Continuing	Continuing

Note

Note: Funds from Project 01SP have been moved to Project 4349 within this Program Element to more accurately align efforts.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop advanced sensing and life prediction technologies to identify damage and characterize the health of aging aerospace structures, propulsion systems, and complex, low-observable (LO) materials and structures. Note: In FY 2010, funds were reduced to fund higher Air Force priorities. In FY 2008: Matured modeling and simulation methodologies for rapid assessment of multiple NDI/E technologies for depot level inspections. Validated NDI/E technologies for inspection of thick (multi-layer) aging aircraft structures with complex geometries. Initiated studies of harsh environment sensors to enable health management for turbine engines and thermal protection systems. 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	6.834	6.839	3.012	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials		PROJECT NUMBER 624349

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
in temperature, strain, pressure, and vibration to enable on-demand health status of turbine engines, aircraft structures, wiring systems, and thermal protection systems. In FY 2010: Advance novel sensing methods and techniques to detect and track damage to other materials and components for aerospace systems. Augment multi-layer sensing capabilities to more extensive applications and potential alternative damage modes on aerospace structures. Augment development of sensing technology to detect changes in material properties, damage evolution, and other factors that detrimentally affect aerospace systems. Develop materials-damage predictive approaches to engine and structure prognosis for life cycle management and life extension capability. Develop and demonstrate novel LO point inspection probes to enable rapid assessment of LO material performance.				
MAJOR THRUST: Develop support capabilities, information, and processes to resolve problems with materials in the production and repair of systems components and structures. In FY 2008: Developed advanced techniques to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Developed advanced materials and processes technologies to repair Air Force legacy systems and test failure limits for emerging Air Force systems. Initiated 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. Demonstrated technologies for improved maintainability of advanced LO materials and designs, such as conductive outer-mold-line, applique, door edges and seals, and multifunctional systems. 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 technologies 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, such as 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. Demonstrate and transition	5.268	5.163	4.944	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials		PROJECT NUMBER 624349

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
technologies for improved maintainability of advanced LO materials and designs, such as conductive outer-mold-line, applique, door edges and seals, and multifunctional systems. In FY 2010: Evaluate advanced materials and processes technologies to repair Air Force legacy systems and test failure limits for emerging Air Force systems. Develop and demonstrate test methods and techniques to understand the effects of in-service environments and materials processes, such as 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. Demonstrate and transition technologies for improved maintainability and life cycle cost of advanced LO materials and designs, such as conductive outer-mold-line, applique, door edges and seals, and multifunctional systems. Develop and demonstrate laboratory test methods to evaluate and characterize candidate space materials for properties and material behavior suitable for use in space applications.				
MAJOR THRUST: Develop support capabilities, information, and processes to resolve materials problems and provide electronic and structural failure analysis of components. In FY 2008: Performed quick response failure analysis and materials investigations for fielded system, acquisition organization, depot system materials failures, and provided advanced materials solutions to ensure system availability and safety of flight. Developed advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Demonstrated advanced test methodologies for analyzing structural failures of emerging materials for Air Force systems. Developed advanced wiring materials technologies to replace aging wiring systems and new wiring technologies for emerging weapons systems. 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.	6.233	6.609	6.356	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624349	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: 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.					
CONGRESSIONAL ADD: Accelerated Insertion of Advanced Materials and Certification for Military Aircraft Structure Material Substitution and Repair. In FY 2008: Conducted Congressionally-directed effort for Accelerated Insertion of Advanced Materials and Certification for Military Aircraft Structure Material. In FY 2009: Conduct Congressionally-directed effort for Accelerated Insertion of Advanced Materials and Certification for Military Aircraft Structure Material Substitution and Repair. In FY 2010: Not Applicable.		2.743	2.992	0.000	
CONGRESSIONAL ADD: Aircraft Active Corrosion Protective Compounds. In FY 2008: Conducted Congressionally-directed effort for Aircraft Active Corrosion Protective Compounds. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.979	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials		PROJECT NUMBER 624349

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: Aircraft Fatigue Modeling and Simulation. In FY 2008: Conducted Congressionally-directed effort for Institute for Science and Engineering Simulation (ISES) / Aircraft Fatigue Modeling and Simulation. In FY 2009: Conduct Congressionally-directed effort for Aircraft Fatigue Modeling and Simulation. In FY 2010: Not Applicable.	2.448	2.992	0.000	
CONGRESSIONAL ADD: Conducting Polymer Stress and Damage Sensors for Composites. In FY 2008: Conducted Congressionally-directed effort for Polymer Stress and Sensor Damage Sensors for Composites. In FY 2009: Conduct Congressionally-directed effort for Conducting Polymer Stress and Damage Sensors for Composites. In FY 2010: Not Applicable.	2.841	1.436	0.000	
CONGRESSIONAL ADD: Science for Sustainment. In FY 2008: Conducted Congressionally-directed effort for Science for Sustainment Initiative to Improve Mission. In FY 2009: Conduct Congressionally-directed effort for Science for Sustainment. In FY 2010: Not Applicable.	1.566	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials	PROJECT NUMBER 624349

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: LGX High Temperature Acoustic Wave Sensors. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for LGX High Temperature Acoustic Wave Sensors. In FY 2010: Not Applicable.	0.000	1.596	0.000	

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603112F/ Advanced Materials for Weapons Systems.	0.000	0.000							Continuing	Continuing
PE 0603211F/ Aerospace Technology Dev/Demo.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials	PROJECT NUMBER 624349

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602102F Materials					PROJECT NUMBER 624915	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
624915: Deployed Air Base Technology	18.106	10.817	3.933						Continuing	Continuing

Note

Note: FY 2008 funding totals include $3.7 million in supplemental funding.

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 Expeditionary Combat Support operations.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop new deployable airbase technologies including energy and aircraft operating surfaces to reduce airlift and manpower requirements, setup times, and sustainment costs in support of AEF operations, while providing for autonomous operations. In FY 2008: Developed and analyzed solar power for bare base applications. Transitioned fuel cell reformer specification for acquisition. Began development of advanced integrated power technologies. Investigated and evaluated high temperature effects on operating surfaces and developed repair technology. Demonstrated nondestructive inspection of airfield surface evaluation technologies. Demonstrated cost effectiveness and performance of synthesized polymer materials. In FY 2009: Analyze and demonstrate renewable power technologies applicable to deployed forces. 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.	2.906	1.650	2.177	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624915	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Develop deployable applications of higher efficiency collection and conversion of solar power for deployed applications. Analyze performance of candidate high temperature aircraft operating surface materials. Develop remote nondestructive inspection of airfield surface evaluation technologies.					
MAJOR THRUST: Develop affordable technologies to provide force protection and survivability to AEF deployed warfighters and infrastructure. In FY 2008: Developed methodologies to characterize candidate fire suppression agents and began development of supporting fire suppression technologies for crash/rescue. Developed and evaluated combined technologies for fire fighter effectiveness. Demonstrated and analyzed effectiveness of resilient structural materials and methodologies for improved protection of structures and inhabitants. Investigated and analyzed effectiveness of innovative improvised explosive detection and defeat for high energy threat. Investigated mechanisms of gas phase kinetics. Developed and evaluated accuracy for atmospheric models for protection of deployed warfighters from asymmetric threats. 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 improvised explosive device (IED) and high energy threats. In FY 2010: Analyze fire suppression agents using methodologies supporting deployed warfighters and infrastructure. Investigate novel, cost-effective technologies for fire fighter effectiveness and optimize developed technologies. Investigate novel structural materials and technologies to support deployed warfighters and infrastructure, using methodologies developed for protection. Analyze and conduct experiments to verify effectiveness for defeat of IED and high energy threat technologies. Transition mature defeat technologies and investigate emerging threats. Explore functions of microbes and develop effective methodologies to capture biological processes for use in Air Force applications.		3.171	1.986	1.756	

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APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624915	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Blast Resistant Concrete Products. In FY 2008: Conducted Congressionally-directed effort for Blast Resistant Concrete Products. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.566	0.000	0.000	
CONGRESSIONAL ADD: Life Shield Blast Resistant Panels. In FY 2008: Conducted Congressionally-directed effort for Life Shield Blast Resistant Panels. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.981	0.000	0.000	
CONGRESSIONAL ADD: Fire and Blast Resistant Materials for Force Protection. In FY 2008: Conducted Congressionally-directed effort for Fire and Blast Resistant Materials for Force Protection. In FY 2009: Conduct Congressionally-directed effort for Fire and Blast Resistant Materials for Force Protection. In FY 2010: Not Applicable.		1.566	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624915	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Advanced Carbon Fiber Research and Testing Initiative. In FY 2008: Conducted Congressionally-directed effort for Advanced Carbon Fiber Research and Testing Initiative. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		2.940	0.000	0.000	
CONGRESSIONAL ADD: Advanced Aerospace Carbon Foam Heat Exchangers. In FY 2008: Conducted Congressionally-directed effort for Advanced Aerospace Carbon Foam Heat Exchangers. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.566	0.000	0.000	
MAJOR THRUST: Counter-Improvised Explosive Device - Explosive Detection Technology. In FY 2008 GWOT: Evaluated sampling technologies to allow screening for explosives in packages, luggage, personnel, and entry control points. Evaluated detectors for emerging threats. Identifed suitable explosives detectors and sample collectors for field deployment. In FY 2009: Not Applicable.		2.858	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624915	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
MAJOR THRUST: Hardened Expeditionary Structures. In FY 2008 GWOT: Developed expeditionary structure designs/technologies with blast and ballistic protection against 120 mm mortar and 122 mm rocket threats. Designs included complete structures, stand-alone overhead protection systems, and complete troop housing systems that are easy to ship, assemble, disassemble, and repackage for transport. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.276	0.000	0.000	
MAJOR THRUST: Composite Rubberized Concrete (CRC) for Blast Applications. In FY 2008 GWOT: Designed, developed, and validated protective systems using recycled rubber as an additive aggregate to conventional concrete to improve blast resistance, with a particular emphasis on reducing secondary concrete fragments produced by the blast. Goal was to reduce or mitigate the spalling effect of conventional concrete, while maintaining structural strength. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.276	0.000	0.000	
CONGRESSIONAL ADD: Advanced Military Installations that Integrate Renewable Energy and Advanced Energy Storage Technologies.		0.000	3.989	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials			PROJECT NUMBER 624915	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Advanced Military Installations that Integrate Renewable Energy and Advanced Energy Storage Technologies. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Tactical Shelters Next Generation Composite Initiative. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Tactical Shelters Next Generation Composite Initiative. In FY 2010: Not Applicable.		0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F Materials	PROJECT NUMBER 624915

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603112F/ Advanced Materials for Weapon Systems.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	135.401	123.036	127.129						Continuing	Continuing
622401: Structures	36.667	37.310	44.494						Continuing	Continuing
622403: Flight Controls and Pilot-Vehicle Interface	40.741	33.885	28.874						Continuing	Continuing
622404: Aeromechanics and Integration	57.993	51.841	53.761						Continuing	Continuing

A. Mission Description and Budget Item Justification

This program investigates, develops, and analyzes aerospace 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.

This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary aerospace vehicle technologies.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	139.855	122.870	143.289	
Current BES/President's Budget	135.401	123.036	127.129	
Total Adjustments	-4.454	0.166	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.334		
Total Congressional Increases	0.000	4.100		
Total Reprogrammings	-2.017	-3.600		
SBIR/STTR Transfer	-2.437	0.000		

Change Summary Explanation

Note 1: In FY 2008, Congress added $1.9 million for Advancement of Intelligent Aerospace Systems (AIAS) for the U.S. Air Force, $0.9 million for Cognitive Unmanned Air Vehicle, $0.9 million for Modeling and Simulation for Rapid Integration and Technology Evaluation, $3.9 million for Characterization of Airborne Environment for Tactical Lasers, and $0.7 million for Single-Mode Optical Connectors for Advanced Air Vehicles. Note 2: In FY 2009, Congress added $0.5 million for Cognitive Unmanned Air Vehicle

(U) C. Performance Metrics
Under Development

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies					PROJECT NUMBER 622401	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
622401: Structures	36.667	37.310	44.494						Continuing	Continuing

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 aerospace 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop an economic service life analysis capability comprised of analysis tools, methodologies, and structural health monitoring schemes. Note: Increased funding in FY 2010, is due to increased emphasis being placed on service life extension initiatives. In FY 2008: Based upon results of demonstration efforts in Program Element 0603211F - Aerospace Technology Dev/Demo, refined development of structural health management schemes for structures susceptible to damage. Continued the development of economic service life analysis and structural design tools for current and future aircraft, enhancing capabilities, component replacement, and technology direction. Continued the development of analysis tools into life prediction and failure analysis. Continued to develop failure criteria tools for advanced high temperature aircraft components and concepts. 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. Continue the development of analysis tools into life prediction and failure analysis. Continue to develop failure criteria tools for advanced high temperature aircraft components and concepts. In FY 2010: Initiate the development of health reasoners for determination of system health. Continue the development of economic service life analysis and structural design tools for current and future aircraft,	3.705	3.593	26.163	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies			PROJECT NUMBER 622401	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
enhancing capabilities, component replacement, and technology direction. Continue to 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. Continue the development of residual stress processes to enhance service life.					
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. In FY 2008: Continued the development of analytical certification methodologies that incorporate advanced methods, concepts, diagnostic techniques, and manufacturing technologies into aircraft components and airframe design. Incorporated 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. In FY 2009: Continue development of analytical certification methodologies that incorporate advanced methods, concepts, diagnostic techniques, and manufacturing technologies into 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. In FY 2010: Continue development of analytical certification methodologies that incorporate advanced methods, concepts, diagnostic techniques, and manufacturing technologies into aircraft components, airframe design and mission planning. Initiate the development of response prediction methodologies. Based on work performed on reliability for structures components, initiate development of reliability based certification.		3.716	3.322	4.043	
MAJOR THRUST: Develop design methods to capitalize on new materials, multirole considerations, and integration of various subsystem hardware items (e.g., antennas, sensors, direct energy weapon components,		16.442	17.017	5.806	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER 622401

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
and integrated energy storage) and adaptive mechanisms into the actual aircraft structures and/or skin of the aircraft. Note: Decreased funding in FY 2010 is due to higher Air Force priorities. In FY 2008: Continued 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. Continued 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. Continued 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. Initiated characterization of high energy laser concepts. Initiated development, evaluation, and assessment of multi-functional structures to include ground demonstration of energy storage concepts, integrated distributed electronics, and homogeneous sensor integration systems. 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, which provides for increased energy efficiencies. 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 structures to include ground demonstration of energy storage concepts, integrated distributed electronics, and homogeneous sensor integration systems. In FY 2010: Continue the development of multirole aircraft structural concepts. 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. Continued the development, evaluation, assessment, and ground testing of adaptive structures, subsystem hardware, and antenna integration into load-bearing structures to create				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies			PROJECT NUMBER 622401	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
multi-function or ultra-lightweight concepts. Continue the development, analysis, and evaluation of innovative technologies that integrate active aeroelastic design concepts, adaptive structures, aerodynamic flow control technologies and aerodynamic handling/maneuverability to enable viable long-range and long endurance air vehicle and micro air vehicle concepts. Continue development, evaluation, and assessment of multi-functional structures to include ground demonstration of energy storage concepts and integrated distributed electronics.					
MAJOR THRUST: Develop technologies that will permit the structural development of aircraft that can operate at an extreme altitude, while at sustained speeds greater than Mach 2. Note: Decreased funding in FY 2010 is due to having completed efforts in FY 2009. In FY 2008: Further developed 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. Incorporated newly developed structural concepts and analysis methods for design and evaluation of hot primary structure. 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. In FY 2010: 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 the development of concepts to advanced, all weather, durable, thermal protections systems. Continue and refine operationally responsive space access concepts. Initiate research to develop and apply these technologies for lower cost, reduced weight expendable vehicle airframes.		12.804	13.378	8.482	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER 622401

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0603112F/ Advanced Materials for Weapon Systems.	0.000	0.000							Continuing	Continuing
PE 0603211F/ Aerospace Technology Dev/Demo.	0.000	0.000							Continuing	Continuing
PE 0604015F/ Next Generation Bomber.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies					PROJECT NUMBER 622403	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
622403: Flight Controls and Pilot-Vehicle Interface	40.741	33.885	28.874						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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: Decreased funding in FY 2010 is due to higher Air Force priorities. In FY 2008: 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. Completed development of high-density optical component technologies for adverse environments that reduce subsystem size, weight, and cost while considering maintainability. Completed systems design for safety-critical electromagnetic tolerant systems. Completed the assessment of enhanced tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Completed refinement of actuation fault compensation technologies for integrated vehicle health management. 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	19.307	17.997	7.981	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies			PROJECT NUMBER 622403	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2010: Further the development, assessment, and certification of advanced control mechanization technologies to provide highly reliable operations for manned and unmanned systems under adverse environments at significantly reduced size, weight, and cost. Develop control configurations for small and micro-sized unmanned air vehicles to enable air deployment as well as operations in complex and urban environments.					
MAJOR THRUST: Develop flight control systems that will permit safe interoperability between manned and unmanned aircraft. Concepts will also provide mission responsiveness and adaptability for improved operational effectiveness of manned and unmanned systems. Note: Increased funding in FY 2010 is due to increased emphasis being placed on interoperability between unmanned platforms and manned platforms. In FY 2008: Continued to develop and assess novel control automation techniques and adaptive algorithms to enable safe and interoperable application of manned and unmanned aerospace systems. Continued to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Continued development and assessment of cooperative control techniques for close-in surveillance of urban environments. Completed control and situational awareness requirements development for interoperability of unmanned vehicles in terminal area and ground operations. Developed and assessed adaptive guidance and control technologies for fault/damage tolerant aerospace vehicle operations. 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.		9.817	8.665	16.426	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies			PROJECT NUMBER 622403	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Continue to develop and assess novel control automation techniques and adaptive algorithms to enable safe, interoperable, and integrated application of manned and unmanned aerospace systems. Initiate reliability and performance analysis of mixed-initiative control of multi-unmanned vehicle packages. Initiate development and assessment of cooperative control techniques of heterogeneous systems for close-in surveillance. Initiate technology development for the safe interoperability of unmanned vehicles in airspace, the terminal area, and ground operations. Refine the development and assessment of adaptive guidance and control technologies for fault/damage tolerance and rapid flight planning of aerospace vehicle operations.					
MAJOR THRUST: Develop tools and methods for capitalizing on simulation-based research and development of future aerospace vehicles. In FY 2008: Refined network-centric environment to broaden advanced technology assessment capability. Expanded the breadth of simulation analyses in refined net-centric environment to address multi-directorate technology trade studies for refined long-range strike and reconnaissance concepts. Continued technology trade studies for next generation theater transports. Conducted simulations to analyze advanced launch and reentry technologies for access-to-space concepts. Continued technology trade studies of small and medium sized unmanned air vehicles in hostile urban environments. 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. In FY 2010: Refine multi-disciplinary, net-centric simulation environments and models to enable the quantitative and qualitative assessment of advanced aerospace vehicle concepts and technologies under realistic mission conditions. Design and conduct simulation events to evaluate and assess the military utility		6.931	6.724	4.467	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies			PROJECT NUMBER 622403	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
and suitability of new technologies and new aerospace concepts. Continue simulation analyses and multi-directorate technology trade studies on strike, transport, access-to-space, and reconnaissance concepts. Continue technology trade studies of small and medium sized unmanned air vehicles in hostile urban environments.					
CONGRESSIONAL ADD: Advancement of Intelligent Aerospace Systems (AIAS) for the U.S. Air Force. In FY 2008: Conducted Congressionally-directed effort for Advancement of Intelligent Aerospace Systems (AIAS) for the U.S. Air Force. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.953	0.000	0.000	
CONGRESSSIONAL ADD: Cognitive Unmanned Air Vehicles. In FY 2008: Conducted Congressionally-directed effort for Cognitive Unmanned Air Vehicles. In FY 2009: Conduct Congressionally-directed effort for Cognitive Unmanned Air Vehicles. In FY 2010: Not Applicable.		0.976	0.499	0.000	
CONGRESSIONAL ADD: Modeling and Simulation for Rapid Integration and Technology Evaluation. In FY 2008: Conducted Congressionally-directed effort for Modeling and Simulation for Rapid Integration and Technology Evaluation.		0.976	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies			PROJECT NUMBER 622403	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Not Applicable. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Single-Mode Opitcal Connectors for Advanced Air Vehicles. In FY 2008: Conducted Congressionally-directed effort for Single-Mode Opitcal Connectors of Advanced Air Vehicles. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.781	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER 622403

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603211F/ Aerospace Technology Dev/Demo.	0.000	0.000							Continuing	Continuing
PE 0604015F/ Next Generation Bomber.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies					PROJECT NUMBER 622404	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
622404: Aeromechanics and Integration	57.993	51.841	53.761						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops aerodynamic configurations of a broad range of revolutionary, affordable aerospace 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop aerodynamic prediction efforts centered on expanding the design capabilities of manned and unmanned air vehicles. Note: In FY 2010, efforts in this thrust were reduced due to higher AF priorities. In FY 2008: Continued efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions, including offensive missions, to reduce life cycle costs and decrease human risk. Continued to perform mission assessment and develop low-cost unmanned air vehicle concept to perform tactical surveillance and weapon delivery. Continued 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. Initiated development of fluid-based thrust vectoring concepts for unmanned air vehicles. Continued to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles. 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 concepts 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	4.061	3.508	2.700	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies			PROJECT NUMBER 622404	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
unmanned air vehicles. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles. In FY 2010: Continue to perform mission assessments and develop low-cost unmanned air vehicle concepts to perform current and future missions including tactical surveillance and weapon delivery. Continue to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions to reduce life cycle costs and decrease human risk. Continue development of technologies for improved weapon delivery and propulsion system performance. Continue work to develop and demonstrate flow control to enable fluidic thrust vectoring, area control, and thermal management for an unmanned air vehicle exhaust nozzle. Continue development of innovative aerodynamic control methods for small unmanned air vehicles.					
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: Decrease in FY 2010 due to moving the Energy Conservation - Assured Fuels Initiative support to the major thrust for technologies for the next generation of multi-role large aircraft. In FY 2008: Continued the 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. Initiated study of energy-based analysis and optimization techniques for vehicle design. Evaluated supersonic tailless aerodynamic concepts. Initiated efforts to characterize hypersonic phenomena and develop and validate fundamental hypersonic component technologies through experimental flight techniques in a relevant high-speed environment. Initiated efforts to integrate self-defense systems to counter multi-spectrum system threats. Evaluated sub-scale aerodynamic integrated inlet concepts on high efficiency aero configurations for system level performance. Evaluated thermally integrated structures for lightweight integrated exhaust systems and airframes. Continued high fidelity aerodynamic testing of advance control techniques for low-speed and high-speed operation. Validated analytical stability and control simulations for system level operability. Note: Provided support to SECAF-directed effort (Energy Conservation - Assured Fuels Initiative) to identify and develop technologies that		25.031	21.121	15.044	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER 622404

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
provide revolutionary aircraft configurations that enable the use of domestic fuel sources for military energy needs. 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. In FY 2010: Continue development and assessment of aerospace technologies that enable sustained high-speed flight to permit global reach. Continue development of technologies and configurations for high performance airframe propulsion integrations for reusable and expendable high-speed aerospace vehicles. Continue development of analysis/design techniques and tools to enable shock/boundary layer interaction flow control and enhanced stability for high speed propulsion concepts. Initiate development and demonstration of high performance high speed mixed compression inlet concepts utilizing advanced flow control technologies for Mach 3+ expendable systems. Develop and test inlet variable geometry concepts that meet balanced mission performance and survivability requirements. Initiate work to demonstrate key propulsion integration technologies and propulsion flow path configurations that work in concert with variable cycle engines to enable revolutionary system performance for supersonic long range strike applications. These vehicle configurations will also have efficient subsonic loiter capabilities and will meet balanced mission performance and survivability requirements. Continue efforts to integrate self-defense systems to counter multi-spectrum system threats. Continue to develop advanced high-speed aero/flight control and study of aeroelastic effects for high speed vehicles. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through experimental flight techniques in a relevant environment. Initiate work				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies			PROJECT NUMBER 622404	
B. Accomplishments/Planned Program ($ in Millions)		FY 2008	FY 2009	FY 2010	FY 2011
to develop vehicle concepts and technologies to enable safe and reliable store dispense/separation at Mach 4 and above.					
MAJOR THRUST: Develop new and improved concepts, designs, and analysis of technologies to enable revolutionary capabilities for re-useable, high altitude vehicle. Note: Decreased funding in FY 2010 is due to higher Air Force priorities. In FY 2008: Continued development and assessment of aerospace technologies that enable reusable, space-access vehicle. Developed robust design methodology and integration approaches for high-speed aeropropulsion. Developed extensive application and 3-D validation experience in applying aerothermal computational tools to conceptual, ground-tested and flight-tested vehicles traveling at high-speeds. Developed unique high temperature structures and materials in support of re-usable space-access aircraft. Pursued multi-disciplinary optimization of complex high speed, high temperature, reusable air vehicles. In FY 2009: Continue development and assessment of aerospace technologies that enable re-usable, space-access vehicle. Enhance robust design methodology and integration approaches for high-speed aeropropulsion. Continue extensive application and 3-D 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, re-usable air vehicles. Initiate design and test of components of integrated high-speed, space-access air vehicle system. In FY 2010: Continue development and assessment of aerospace technologies that enable re-usable, space-access vehicle. Continue extensive application and 3-D validation efforts in applying aerothermal and material response computational tools to conceptual, ground-tested and flight-tested vehicles traveling at high-speeds. Continue development of multi-disciplinary optimization methods for complex high-speed, high temperature, re-usable air vehicles. Continue development of the robust hypersonic propulsion design methodology and exploration of advanced hypersonic propulsion integration approaches. Continue design and testing of components, subsystems and integrated systems for high-speed space-access vehicles. Initiate work to		6.717	7.965	2.060	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
develop and validate technologies and methods for assessing the operability, availability and operational cost of high speed flight vehicles and reusable space access systems.					
MAJOR THRUST: Develop enabling technologies to allow integration of directed energy weapons into current and future air vehicle platforms. In FY 2008: Initiated development of combined flow control and adaptive optics systems to optimize directed energy system performance on large low-speed aircraft. Initiated development of analysis tools for predicting the performance of advanced flow control and adaptive optics systems. 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. In FY 2010: Continue development of combined flow control and adaptive optics systems to optimize directed energy system performance on large low-speed aircraft. Initiate work to apply advanced analysis tools to predict the performance of flow control and adaptive optics systems for capabilities of interest to the Air Force.		2.278	1.205	2.210	
MAJOR THRUST: Develop and assess technologies for the next generation of multi-role large aircraft. Note: Increase in FY 2010 is due to moving the Energy Conservation - Assured Fuels Initiative into this major thrust. In FY 2008: 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. Continued to develop technologies that enable multiple roles and missions for delivery and support aircraft. Initiated trade studies between short take-off and landing performance and high-speed cruise. Conducted development of inlet and integration technologies for an advanced mobility platform designed to operate efficiently at transonic speeds and provide short take-off capabilities.		16.000	18.042	31.747	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies			PROJECT NUMBER 622404	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Continue 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. Continue support to SECAF-directed effort (Energy Conservation - Assured Fuels Initiative). Conduct wind tunnel experiments and multidisciplinary design concept assessments to show the feasibility of mobility aircraft using 40% less energy through the use of natural and artificial laminar boundary layers, alternative fuels, and very high bypass propulsion integration. In FY 2010: Continue development and assessment of aeronautical technologies including high-lift systems, transonic configuration optimization, 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.					
CONGRESSIONAL ADD: Wright Brothers Institute (WBI) - Characterization of Airborne Environment for Tactical Lasers. In FY 2008: Conducted Congressionally-directed effort for WBI - Characterization of Airborne Environment for Tactical Lasers. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		3.906	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER 622404

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603211F/ Aerospace Technology Dev/Demo.	0.000	0.000							Continuing	Continuing
PE 0604015F/ Next Generation Bomber.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	90.603	93.222	85.122						Continuing	Continuing
621123: Learning and Organizational Collaboration	17.972	18.349	13.537						Continuing	Continuing
625328: Human Dynamics Evaluation	0.000	0.000	18.280						Continuing	Continuing
625329: Sensory Evaluation and Decision Science	0.000	0.000	21.202						Continuing	Continuing
627184: Performance Evaluation in Extreme Environments	44.504	55.935	16.964						Continuing	Continuing
627757: Directed Energy Bioeffects	28.127	18.938	15.139						Continuing	Continuing

Note

Note: In FY 2010, Human Dynamics Evaluation efforts will move from Project 7184 to Project 5328, Sensory Evaluation and Decision Science efforts will move from Project 7184 to Project 5329, and Performance Evaluation in Extreme Environments efforts within Project 7757 will move to Project 7184 to better align efforts.

A. Mission Description and Budget Item Justification

This program conducts applied research on Airmen training, Airmen system interfaces, directed energy bioeffects, deployment and sustainment of Airmen in extreme environments, and understanding and shaping adversarial behavior. The Learning and Organizational Collaboration project conducts research to measure, accelerate, and expand the cognitive skills necessary to improve Airmen training and mission performance. The Human Dynamics Evaluation project conducts research to advance information operations and intelligence operator-aiding technologies by developing and applying human-focused research to create and influence behavior signatures of existing and emerging adversaries. The Sensory Evaluation and Decision Science project conducts research to revolutionize the manner in which the human optimizes the capabilities of Air Force systems, including autonomous unmanned aerial systems (UAS) and adaptive teams of humans and machines. The Performance Evaluation in Extreme Environments project conducts research to enhance human sensory, cognitive, and physical capabilities to increase Airmen survivability and performance. The Directed Energy Bioeffects project conducts research on the effects of human exposure to electromagnetic energy (radio frequency

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
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to optical), scalable directed energy weapons, and non-lethal weapons. 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. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	92.068	82.091	92.603	
Current BES/President's Budget	90.603	93.222	85.122	
Total Adjustments	-1.465	11.131	0.000	
Congressional Program Reductions	0.000	-0.016		
Congressional Rescissions	0.000	-0.253		
Total Congressional Increases	0.000	13.800		
Total Reprogrammings	-0.275	-2.400		
SBIR/STTR Transfer	-1.190	0.000		

Change Summary Explanation

In FY 2009, Congress added $3.0 million for Homeland Emergency Learning and Preparedness (HELP) Center, $2.0 million for Imaging Tools for Human Performance Enhancement and Diagnostics, $0.8 million for Smart View Program (SVP), $0.8 million for Tools and Technologies for Incident and Consequence Management, $1.6 million for Component Object Model Attitude Control System Simulation/Trainer, and $3.2 million for Ultra High Resolution Deployable Projector for Simulation.

C. Performance Metrics

Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research					PROJECT NUMBER 621123	
COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
621123: Learning and Organizational Collaboration	17.972	18.349	13.537						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project conducts applied research to measure, accelerate, and expand the cognitive skills necessary to improve Airmen training and mission performance. Research is conducted in three focus areas: immersive environments; continuous learning and aiding; and cognitive and behavioral modeling. The immersive environments effort creates live, virtual, and constructive (LVC) decision-making environments for use in developing revolutionary simulation technologies to increase training capabilities. Continuous learning and aiding enhances training effectiveness and efficiency by using learning theory to improve military training and mission performance. Cognitive and behavioral modeling creates realistic models and simulations of human behavior to advance the understanding of how people perform complex tasks.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: The immersive environments focus area will research methods to enhance Distributed Mission Operations (DMO) and decision dominance environments. Identify the visual requirements necessary for realistic aircrew training and mission rehearsal, allowing AF warfighters to train as they intend to fight. Create the capability for seamless, high-fidelity, fully-immersive participation in LVC environments to include air, cyber, and space domains. Provides warfighters with validated approaches to experience, train, and rehearse in immersive environments with weather, weapons, combat, visual, and sensory effects. Note: The increase in funding in FY 2010 is due to increased emphasis in this area. In FY 2008: Researched perceptual issues for out-the-window display and targeting pod simulation systems that will allow for greater realistic composite force training. Explored perceptual characteristics for new deployable visual display technologies. Expanded human factors visual research to define display requirements for a fully immersive collaborative environment for DMO. In FY 2009: Perform human factors analysis, tests, and evaluations of visual and sensor simulation components for air-to-ground and air-to-air composite force training using air-to-surface operational testbed. Conduct perceptual evaluations of compact immersive display concepts and components. Transition results to	1.893	1.814	4.282	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research			PROJECT NUMBER 621123	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
address broader range of AF mission areas and initiate research on sensory-driven decision making in complex environments. In FY 2010: Research training and rehearsal issues for helmet cueing and targeting pod simulation systems that will allow for greater realistic composite force training. Expand sensory-driven modeling efforts to predict targeting pod performance and investigate how neural-sensory measurements correlate with model predictions. Define sensory requirements for a fully immersive collaborative training environment for DMO. Assess modeling and simulation requirements for intelligent threat models to support immersive training. Conduct research for the capabilities needed for a full-threat reaction trainer system. Enhance training capabilities by populating DMO databases with robust 3-D cultural content and correlated sensor attribution.					
MAJOR THRUST: The continuous learning and aiding focus area will research and analyze tools, strategies, and performance support methods for improving personnel selection, Airmen combat mission training, rehearsal, and operations, including command and control, intelligence, surveillance, and reconnaissance (ISR), unmanned aerial system (UAS) and cyber missions. Apply empirical data to develop guidelines for improving learning and decision making in training and rehearsal for combat air forces and global strike operations. Enhance the quality, management, and effectiveness of DMO LVC training, rehearsal, and exercise environments through competency-based training methods. Note: The decrease in funding in FY 2010 is due to decreased emphasis in this area. In FY 2008: Evaluated approaches and tools for integrating principles of learning in LVC environments. Identified methods and tools to manage learning in operational training contexts. Identified and analyzed methods of routinely assessing knowledge and skills for combat readiness. Analyzed field data to identify opportunities for competency-based training integration. Analyzed how to monitor the integration of distributed training and rehearsal into operational readiness contexts. Evaluated common measurement tools for assessing readiness in air-to-air, air-to-ground, and close air support training, rehearsal, and exercise events. Explored scenario sequencing methods for continuous learning. Conducted in-depth analysis of the training related shortfalls of current DMO computer generated forces. Explored hardware and software solutions allowing functional processing of selected friendly/enemy interactions for extremely high fidelity training.		8.486	8.168	5.719	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research			PROJECT NUMBER 621123	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Researched and analyzed 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. 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 LVC contexts 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. In FY 2010: Develop methods for identifying common knowledge, skill, and experience requirements for individuals, teams, and teams-of-teams in manned and unmanned aerospace environments. Develop methods for adapting learning and performance environments to support individual and team training within and across AF and coalition mission areas. Develop tools for routinely tracking and storing experience and performance based on operational activities and training events. Explore methods that permit persistent learning within and across aerospace operational training, rehearsal, exercise, test, and evaluation contexts. Evaluate alternative approaches for training in LVC environments and across tactical, operational, and strategic levels of decision making.					
MAJOR THRUST: The cognitive and behavioral modeling focus area will explore the application of cognitive science for performance improvement by enhancing training in AF mission-relevant environments, including flight simulators and air and space operations centers. Develop computational and mathematical models of human performance and learning as enabling technologies for improving readiness across an assortment of AF career fields, from combat air forces to command and control personnel.		3.669	3.580	3.536	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER 621123

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Expanded the depth of the communication models to support the full range of vocabulary and grammar used in the air and space operations center training environment. Conducted empirical study with skill acquisition/retention models. Extended automation functionality to include dynamic model validity and refinement capability. 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 the ability to produce individualized training programs. Conduct empirical study with skill acquisition/retention models. Validate semi-automated, adaptive parameter search and model optimization capability and implement graphical user interface for performance moderator prediction system. In FY 2010: Create adaptive language comprehension and generation capability for computer-generated communication models. Continue to integrate knowledge and skill tracking prediction system with mission essential competencies to predict individualized, optimized training requirements for Airmen. Broaden ability to model and predict individual differences in trainee susceptibility to cognitive fatigue across multiple tasks.				
CONGRESSIONAL ADD: Component Object Model (COM) Attitude Control System Simulation/Trainer. In FY 2008: Conducted Congressionally-directed effort for COM Attitude Control System Simulation/Trainer. In FY 2009: Conduct Congressionally-directed effort for COM Attitude Control System Simulation/Trainer. In FY 2010: Not Applicable.	3.924	1.596	0.000	
CONGRESSIONAL ADD: Ultra High Resolution Deployable Projector for Simulation. In FY 2008: Not Applicable.	0.000	3.191	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER 621123

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Conduct Congressionally-directed effort for Ultra High Resolution Deployable Projector for Simulation. In FY 2010: Not Applicable.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER 621123

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602233N/ Human Systems Technology.	0.000	0.000							Continuing	Continuing
PE 0602716A/ Human Factors Engineering Technology.	0.000	0.000							Continuing	Continuing
PE 0602785A/ Personnel Performance and Training Technologies.	0.000	0.000							Continuing	Continuing
PE 0603231F/ Crew Systems and Personnel Protection Technology.	0.000	0.000							Continuing	Continuing
PE 0603456F/ Human Effectiveness Adv Tech Dev.	0.000	0.000							Continuing	Continuing
PE 0604227F/ Distributed Mission Training (DMT).	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER 621123

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research					PROJECT NUMBER 625328	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
625328: Human Dynamics Evaluation	0.000	0.000	18.280						Continuing	Continuing

Note

Note: In FY 2010, Human Dynamics Evaluation efforts will move from Project 7184 to Project 5328 to better align efforts.

A. Mission Description and Budget Item Justification

This project conducts applied research to advance information operations and intelligence operator-aiding technologies by developing and applying human-focused research to create and influence behavior signatures of existing and emerging adversaries. Research will be in six focus areas: mission-essential human capabilities for air, space, and cyber operations; enhancing human components of intelligence, surveillance, and reconnaissance (ISR); anticipatory command, control, and intelligence (C2I); adversarial modeling and cross-cultural communication; predicting and evaluating organizational effectiveness alignment and collaboration readiness; and electromagnetic theory. These focus areas will enhance capabilities in layered sensing, decision aids for computer network attack/defense/survive, and human-centric exploitation of measurement and signatures intelligence.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Conduct applied research to identify methods to enhance mission-essential human capabilities for cyber operations. Develop analytical models demonstrating human-optimization concepts for cyber operators in the operations support center environments. Analyze human-centric techniques and models that increase cyber operator situational awareness. Develop measures of effectiveness for cyber capabilities. Define scientific architecture to enhance cognitive cyber performance. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Conduct research to enhance performance and increase situational awareness within cyber operations, including operations support center environments. Develop the operator's ability to anticipate and influence the behavior of adversaries. Conduct foundational studies toward enhancing cognitive cyber performance.	0.000	0.000	6.130	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research			PROJECT NUMBER 625328	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Conduct applied research to enhance human components of ISR. Research human-centered design processes and operational tools that will increase productivity while decreasing cycle times. Develop ability to anticipate, influence, and dominate an adversary's air, space, and cyber ISR systems, processes, and organizations. Develop quantifiable measures of effectiveness to analyze and select advanced ISR mission planning, analysis, and assessment techniques. Analyze means of optimizing information flows among decision makers operating in net-centric, measurement and signatures intelligence (MASINT) environments. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Conduct cognitive task analysis and cognitive systems engineering to develop new intelligence analyst tools, training, and methods to establish and demonstrate dynamic command and control of air, space, and cyber ISR collection capabilities. Specific ISR capability objectives include universal situational awareness, dynamic control of ISR planning, workload reduction, and multi-source/multi-intelligence collaboration.		0.000	0.000	1.600	
MAJOR THRUST: Conduct applied research to develop technology base for an anticipatory C2I decision support environment that uses past and present battlefield mission states to predict adversarial intent and actions. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		0.000	0.000	2.250	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research			PROJECT NUMBER 625328	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Refine knowledge of representation techniques to model potential adversarial behavior and complex systems of systems and begin integrating information within visual displays. Research integrated set of work aids to achieve persistent operational planning, persistent prediction, and focused execution. Develop aids to enhance understanding of underlying C2I models and algorithms.					
MAJOR THRUST: Conduct applied research in adversarial modeling and cross-cultural communication. Concentrate on modeling techniques to gauge adversarial intent and probabilities/methods of attack. Develop models demonstrating quantitative measures of effectiveness of advanced influence operations capabilities. Research and develop automated speech translation tools for obscure languages. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Conduct research to develop behavioral modeling techniques to gauge adversarial threats. Develop measures of effectiveness for selected influence operations capabilities. Develop speech-to-speech translation tools that support automated, cross-cultural communications.		0.000	0.000	6.137	
MAJOR THRUST: Develop models and metrics to predict and evaluate organizational effectiveness alignment and collaboration readiness. Develop organizational simulations and explore opportunities for organizational network analysis. Conduct organizational effectiveness research including work design, organizational assessment, and strategic transformation management. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		0.000	0.000	1.113	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Identify organizational vulnerabilities at the structure, organizational culture, process, or human operator levels. Focus on exploitation of theories involving human trust in automation and interpersonal relationships to provide an understanding of how to influence systems with little to no degree of detection/ suspicion among operators. Develop relevant organizational metrics, work design solutions, and simulation models to facilitate organizational effectiveness.				
MAJOR THRUST: Conduct applied research in the areas of mathematics and electromagnetic theory to exploit/counter adversarial capabilities. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Conduct research on datasets from past/current influence operations. Continue anticipatory research designed to enhance blue force situational awareness of adversarial location and intent.	0.000	0.000	1.050	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603456F/ Human Effectiveness Adv Tech Dev.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research					PROJECT NUMBER 625329	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
625329: Sensory Evaluation and Decision Science	0.000	0.000	21.202						Continuing	Continuing

Note

Note: In FY 2010, Sensory Evaluation and Decision Science efforts will move from Project 7184 to Project 5329 to better align efforts.

A. Mission Description and Budget Item Justification

This project conducts applied research to revolutionize the manner in which the human optimizes the capabilities of AF systems, including autonomous unmanned aerial systems (UAS) and adaptive teams of humans and machines. Research optimizes situational awareness, improves the human-machine interface, and seamlessly integrates warfighters with their weapon systems across air, space, and cyber domains. Research is conducted in four focus areas: network-centric collaboration, supervisory control, battlespace visualization, and battlespace acoustics. The network-centric collaboration area develops warfighter interface technologies to enhance human-human and human-machine collaborations and system interactions in distributed decision-making environments. The supervisory control area develops new control/display concepts and technologies to optimize AF platform capabilities. The battlespace visualization area advances the science and technology associated with collecting, optimizing, displaying, and assimilating sensory information to enhance warfighter decision-making. The battlespace acoustics area researches human-human and human-machine communications to exploit the use of voice and acoustic data in collaborative, net-centric environments while accounting for the effects of acoustic propagation.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: The network-centric collaboration area develops warfighter interface technologies to enhance human-human and human-machine collaboration and system interaction in distributed decision-making environments. These technologies will enable the common operational understanding and shared, distributed decision making required on the modern battlefield. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	0.000	0.000	5.017	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Investigate individual and teams-of-teams performance metrics for team collaboration in a cross-domain distributed environment to include air, space, and cyber. Explore alternate human sensory technologies for operator functional state model development. Begin initial understanding of adaptive interface algorithms for individual operator decision aiding.				
MAJOR THRUST: The supervisory control focus area will research new control/display concepts and technologies (e.g., information portrayal, control devices, and decision aiding algorithms) for AF platforms. Identify the best mix of intelligent methods and traditional design to unambiguously direct operator attention, critical for net-centric operations and UAS operations. Employ real-time and wargaming simulations to quantify operational benefits from new information portrayal concepts. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Design and evaluate advanced visualization concepts to support rapid situation assessment associated with switching tasks, interruptions, and unexpected state changes within multi-UAS control scenarios. Evaluate novel video exploitation aids to enable a single operator to monitor multiple video feeds. Compress critical net-centric and system information onto man-portable UAS interfaces in a manner that permits flexible, high-level tasking without undue workload. Identify techniques that improve operator awareness of UAS automation mode and rationale for autonomous decisions.	0.000	0.000	5.744	
MAJOR THRUST: The battlespace visualization focus area advances the science and technology associated with collecting, optimizing, displaying, and assimilating sensory information to enhance warfighter decision-making. Develop, evaluate, and organize image enhancement techniques for improving input to the visual system through the fusion of multi-spectral sensors to enhance real-time, day/night imaging systems. Devise human-centered command and control visualizations and interaction techniques for integration with visual displays, permitting natural situation understanding of complex information-rich environments.	0.000	0.000	5.902	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Explore vision enhancement techniques to increase rapid classification and identification for objects of interest in air, space, and cyber. Develop visualization technologies and interaction techniques for presenting complex information to enhance air, space, and cyber operations. Investigate presentation and interface technologies for enhancing space situational awareness.					
MAJOR THRUST: The battlespace acoustics focus area researches human-human communications to exploit the use of voice data in collaborative, net-centric environments. Conduct research on three-dimensional audio, active noise reduction, and related technologies that mitigate effects of noise and enhance performance and information processing in the operational environment. In particular, these battlespace acoustic interfaces will integrate with warfighter equipment and amplify information delivery to the warfighter. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Examine applications of how advanced multimodal interfaces can optimize distributed team performance in large-scale communication networks. Conduct research on network-based audio technologies for achieving shared situational awareness and exploiting information from multi-layered arrays of sensors in complex operational environments. Explore the use of persistent audio displays and other advanced auditory cueing techniques for continuously monitoring the status of complex UAS technologies. Conduct research on sensor systems and immersive display technologies for facilitating remote telepresence and optimizing the presentation of complex information in human-machine interfaces.		0.000	0.000	4.539	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603456F/ Human Effectiveness Adv Tech Dev.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
627184: Performance Evaluation in Extreme Environments	44.504	55.935	16.964						Continuing	Continuing

Note

Note: In FY 2010, Human Dynamics Evaluation efforts will move from Project 7184 to Project 5328, Sensory Evaluation and Decision Science efforts will move from Project 7184 to Project 5329, and Performance Evaluation in Extreme Environments efforts within Project 7757 will move to Project 7184 to better align efforts.

A. Mission Description and Budget Item Justification

This project conducts applied research to enhance human sensory, cognitive, and physical capabilities to increase Airmen survivability and performance. The research is focused in four areas: biobehavioral performance, biomechanics, applied biotechnology, counterproliferation. Both biobehavioral and biomechanics focus areas enhance Airmen performance and survivability through dynamic human modeling techniques that define the capabilities and limits of system operators under military-unique stressors, as well as assessing and identifying adversarial threats. Applied biotechnolology advances bioscience, nanotoxicology, and neuroscience research to protect Airmen from the effects of toxic chemicals and materials, and to monitor and enhance cognitive and physiological performance. Counterproliferation research focuses on biotechnology for the detection, identification, monitoring, and neutralization of biological threat agents.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Note: In FY 2010, efforts from this major thrust will move to Project 5328 and Project 5329 to better align efforts. In FY 2008: Developed multinational speech translator technologies for obscure languages and continued to advance technologies that support mobile, speech-based interfaces. Completed a style guide for applying collaborative tools in air battle management command and control environments. Developed a collaboration toolkit for non-airborne command and control missions. Expanded the operator cognitive state assessor to incorporate operator performance data, operator performance and situational awareness models, and tactical situation information for better decision support.	3.958	4.997	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Explore the use of transparent multilingual collaboration tools for distributed multi-entity teaming. Continue development of 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 development of 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. In FY 2010: Not Applicable.					
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. Note: In FY 2010, this major thrust will move to Project 5328 to better align efforts. In FY 2008: Advanced software design patterns that enable the standardization and re-use of human-computer interface elements in command and control ISR systems. Developed a DoD software design patterns library. Developed collaboration techniques and methods to embed these techniques into command and control systems. Demonstrated collaboration techniques in a distributed net-centric environment. Researched the cultural and ethnic bases of human decision making and developed human performance models that reflect cultural differences for effects-based operations. 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. In FY 2010: Not Applicable.		3.552	4.385	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Note: In FY 2010, efforts from this major thrust will move to Project 5328 and Project 5329 to better align efforts. In FY 2008: Transitioned advanced uncertainty visualization techniques for command center displays. Transitioned to advanced development the needed methods to simulate enemy potential courses of action, including more complex adversary behavior. Evaluated results of the laboratory experiments on “sensemaking” tools and displays for dynamic battlefields. Identified gaps for further research. Incorporated the extrapolated, select “sensemaking” results into display development. Refined the knowledge representation techniques to model potential adversaries and complex systems of systems and begin integrating into displays. Initiated transition of integrated set of anticipatory planning and operations (APO) work aids to achieve persistent operational planning, persistent prediction, and focused execution. Conducted initial demonstration of the integration of the developed displays and technologies. 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. In FY 2010: Not Applicable.	1.822	2.237	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop system control interface concepts enabling full operator exploitation of all AF 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. Note: In FY 2010, this major thrust will move to Project 5329 to better align efforts. In FY 2008: Evaluated single operator supervision of multiple autonomous unmanned aerial vehicles (UAV) in a net-centric context using real-time assessment tools and advanced decision support interfaces during testing and simulated ground operations. Transitioned field test results of first generation control-display concepts that reduce operator task loading and channelized attention into second generation control-display workstations. Applied 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. 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. In FY 2010: Not Applicable.	3.675	4.514	0.000	
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 multispectral 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. Note: In FY 2010, this major thrust will move to Project 5329 to better align efforts.	3.693	4.608	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Down-selected and implemented image-enhancing algorithms that are optimized for speed, visual performance, and real-time tactical use. Developed a laboratory-grade test bed usable to perform field tests. Developed and evaluated new and innovative ways to visualize and interact with large amounts of information in visually rich environments. Evaluated display symbologies and mechanizations in simulated air and space operations center environments. In FY 2009: Perform multispectral, real-time field evaluations of display algorithm sets that have been optimized for different tactical scenarios. Refine information portrayal and interaction techniques to enhance decision-making by testing more intuitive visualizations 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 cyberspace understanding in command centers. In FY 2010: Not Applicable.					
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 operational environments, including the cockpit. In particular, these battlespace acoustic interfaces will integrate with warfighter equipment and amplify information delivery to the warfighter. Note: In FY 2010, this major thrust will move to Project 5329 to better align efforts. In FY 2008: Explored 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. Researched ways to adapt current noise models to enhance decision-making and acoustic detectability during offensive operations. Developed auditory information-aiding technologies for remote collaboration, by exploiting advances in communication theory for individuals. Explored the individual and group processes that lead to communication breakdown. Explored improved auditory sensing to create virtual auditory reality for human interface to remote sensing.		3.233	3.826	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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 explore 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. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop integrated human-centered Information/Cyber Operations 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 Information Operations (IO)/ISR/Cyber operators' use in performing their respective missions. Note: In FY 2010, this major thrust will move to Project 5328 to better align efforts. In FY 2008: Validated conceptual human-system interfaces for additional MASINT capabilities. Developed and validated tools and models for assessing the effectiveness of influence operations. Researched and developed tools and capabilities for Influence Operations and counter-Influence Operations. Developed tools and models for assessing the effectiveness of influence operations. Researched and validated speech-to-speech translation tool. Developed capability to anticipate adversarial behavior, both individually and in groups. Researched counter-improvised explosive device solutions. 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		9.091	11.912	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
operations domain. Investigate methods to enhance human ability to uncover concealed information. Develop collaborative tools and training for ISR team applications with emphasis on distributed operations. In FY 2010: Not Applicable.				
MAJOR THRUST: Develop protective system technologies to provide sanctuary from threats to military personnel. 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. Quantify culturally-relevant physical behaviors to understand human performance and threat signatures. Develop databases of human motion, actions, reactions, and features across diverse populations and environments in order to make predictions of impending physical actions, especially in regards to threat detection. In FY 2008: Conducted 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, developed technologies to reduce musculoskeletal disabilities and injuries due to personal equipment and workstation designs. Developed procedures and training improvements to reduce high training attrition due to injury, especially focused on battlefield Airmen training. Expanded initial biomechanics collaborative information system to coordinate DoD biomechanics data collections and analysis capabilities. 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 biomechanics collaborative information technologies to collect and analyze data to protect forces against threats in hostile environments. In FY 2010: Use principles of biomechanics to analyze behavioral data. Collect motion data and develop initial analysis techniques to identify behaviors that seem out-of-context. Include cultural information to	3.534	4.698	4.503	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
develop physical behavior signatures. Integrate information from multiple sensors to help identify a human threat.					
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. In FY 2010, this effort merges with major thrust from Project 7757 to better align efforts. In FY 2008: Conducted behavioral research to characterize human performance and mitigate cognitive degradation during demanding military operations. Developed real-time biobehavioral performance monitoring technology to evaluate cognitive readiness and decision making in command and control applications, tactical operations, and mission rehearsal. Explored emerging cognitive disruption technologies and potential countermeasures. 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. In FY 2010: Use performance databases to refine warfighter physical training programs with the goal of improving retention and operational performance. Conduct research integrating behavioral psychology and metabolomic research to enhance human performance in multiple stressor environments.		1.191	1.066	2.733	
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		1.769	1.941	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
properly balance mission and force protection requirements. Note: In FY 2010, this effort is combined with the next major thrust to better align efforts. In FY 2008: Developed and applied 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, explored and created integrated new sensor and material constructs for AF applications. 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. In FY 2010: Not Applicable.					
MAJOR THRUST: The applied biotechnology focus area will conduct research using biotechnologies and nanotechnologies to produce advances in warfighter performance. Develop, demonstrate, and apply experimental models and predictive algorithms for enhancing biosensors and interpretation of data from layered sensors. Define toxicological aspects of emerging operational environments. Leverage toxicological/ biological data to create new bio/nanotechnologies and algorithms to improve human performance and decision-making abilities. In FY 2008: Conducted genomic, proteomic, and metabolite studies to identify target-organ biomarkers and their assessment methods for hazardous agent exposure. Completed validation panel for selected kidney biomarkers and down-selected liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on AF personnel.		4.072	3.836	4.813	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER 627184

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2010: Conduct research to identify and validate biomarkers relevant to cognitive and physiological changes that enhance human performance. Conduct analysis of novel AF nanomaterial toxicity. Define cell-based pathway engineering for biosensors of human performance.				
MAJOR THRUST: Develop logistics readiness technology options and perform feasibility studies to support large-scale advanced technology development programs. These technologies will lead to more efficient utilization of logistics resources for Air Expeditionary Force operations. Note: In FY 2009, this effort is terminated due to higher Air Force priorities. In FY 2008: Investigated 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. Investigated 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. 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. In FY 2010: Not Applicable.	1.775	1.332	0.000	
MAJOR THRUST: The counterproliferation area will conduct research to support the detection, identification, neutralization, and assessment of threat agents. Perform counterproliferation research to develop technologies	0.000	0.000	4.915	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research			PROJECT NUMBER 627184	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
that would provide information for air operations in high threat environments. Note: In FY 2010, this major thrust will move from Project 7757 to better align efforts. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Conduct research to develop nanoparticle taggants for line-of-sight, standoff assessment of preemptive airstrike destruction of biological warfare agents. Define preliminary techniques to effectively neutralize genetically-modified biological threat agents. Perform initial research to anticipate impacts of high threat environments on air operations and to provide post-attack situational awareness.					
CONGRESSIONAL ADD: Imaging Tools for Human Performance Enhancement and Diagnostics. In FY 2008: Conducted Congressionally-directed effort for Imaging Tools for Human Performance Enhancement and Diagnostics. In FY 2009: Conduct Congressionally-directed effort for Imaging Tools for Human Performance Enhancement and Diagnostics. In FY 2010: Not Applicable.		1.570	1.995	0.000	
CONGRESSIONAL ADD: Warfighter Pocket XP-Next Gen. In FY 2008: Conducted Congressionally-directed effort for Warfighter Pocket XP-Next Gen. In FY 2009: Not Applicable.		1.569	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research			PROJECT NUMBER 627184	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Homeland Emergency Learning and Preparedness (HELP) Center. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for HELP Center. In FY 2010: Not Applicable.		0.000	2.992	0.000	
CONGRESSIONAL ADD: Smart View Program (SVP). In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for SVP. In FY 2010: Not Applicable.		0.000	0.798	0.000	
CONGRESSIONAL ADD: Tools and Technologies for Incident and Consequence Management. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Tools and Technologies for Incident and Consequence Management. In FY 2010: Not Applicable.		0.000	0.798	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research			PROJECT NUMBER 627184	
B. Accomplishments/Planned Program ($ in Millions)		FY 2008	FY 2009	FY 2010	FY 2011

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER 627184

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602201F/ Aerospace Flight Dynamics.	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0602702F/ Command, Control, and Communications.	0.000	0.000							Continuing	Continuing
PE 0603205F/ Flight Vehicle Technology.	0.000	0.000							Continuing	Continuing
PE 0603231F/ Crew Systems and Personnel Protection Technology.	0.000	0.000							Continuing	Continuing
PE 0603245F/ Flight Vehicle Technology Integration.	0.000	0.000							Continuing	Continuing
PE 0603456F/ Human Effectiveness Adv Tech Dev.	0.000	0.000							Continuing	Continuing
PE 0604706F/ Life Support Systems.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER 627184

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research					PROJECT NUMBER 627757	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
627757: Directed Energy Bioeffects	28.127	18.938	15.139						Continuing	Continuing

Note

Note: In FY 2010, Performance Evaluation in Extreme Environments efforts will move from Project 7757 to Project 7184 to better align efforts.

A. Mission Description and Budget Item Justification

This project conducts applied research on the effects of human exposure to electromagnetic energy (radio frequency to optical), scalable directed energy weapons, and non-lethal weapons. This research addresses fundamental physical principles as well as the psychophysical interaction between directed energy and the individual or groups of individuals. Research is divided into three core focus areas: optical radiation bioeffects, radio frequency radiation (RFR) bioeffects, and biobehavioral systems. Optical radiation bioeffects research enhances combat survivability and systems effectiveness through technologies that enable deployed forces to counter optical threats and exploit optical systems for offensive applications. The RFR bioeffects research focuses on theoretical and empirical dosimetry, bioeffects of short- and long-term exposure, methods to counter RFR threats, and exploitation of directed energy systems for offensive capabilities. Biobehavioral systems research concentrates on the design and characterization of scalable directed energy and novel-effects weapons, and their ability to modify human behavior.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: The optical radiation bioeffects focus area conducts laboratory experiments and field research on laser bioeffects, enabling military exploitation of laser technology while providing countermeasures for optical hazards/threats. In FY 2008: Integrated dynamic bidirectional reflectivity distribution mathematical models into diagnostic tools of laser eye damage for collateral hazard assessments of typical laser systems. Expanded laser damage threshold database for multiple wavelengths to validate DoD, national, and international safety standards. Evaluated impact of visible lasers upon critical aircrew and ground force missions. In FY 2009: Perform field and laboratory experiments to verify and validate optical physics model of bidirectional 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	7.414	6.645	7.528	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research			PROJECT NUMBER 627757	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
laser system demonstrations. Initiate experiments for future high energy laser weapon systems to predict, evaluate, and explore target bioeffects. In FY 2010: Evaluate collateral hazard assessment software model on high energy laser platforms and develop next generation of hazard assessment tools. Further expands laser damage threshold database for multiple wavelengths to validate DoD, national, and international safety standards. Evaluate superthreshold tissue impacts and further define weapon effectiveness parameters. Conduct experiments for future high energy laser weapon systems to predict, evaluate, and explore target bioeffects.					
MAJOR THRUST: The RFR bioeffects focus area conducts 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 electromagnetic (EM) hazards/threats. In FY 2008: Explored tissue interactions from terahertz frequencies to evaluate safe exposure levels and tissue vulnerabilities. Improved EM tissue models to include terahertz and high power EM effects. Conducted research to support fielding and effectiveness of RFR directed energy weapon systems. In FY 2009: Conduct experiments to refine and eliminate gaps in RFR exposure standards for microwave, ultra-wide band, high peak power RFR systems, and terahertz frequency ranges. Integrate and improve human behavior, bioeffects, and target effects computer models based on RFR studies in microwave, ultra-wide band, high peak power, and terahertz sources. Investigate RFR bioeffects as a foundation for future RFR weapons. In FY 2010: Evaluate biological responses to high power and high peak power EM systems from cellular to whole organism perspectives. Validate models of RFR bioeffects through laboratory and field experimentation, as well as applied mathematics. Conduct research to support fielding and effectiveness of scalable directed energy weapon systems. Conduct research into the bioeffects and safety of terahertz sources.		7.050	6.520	7.216	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER 627757

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: The biobehavioral sciences focus area concentrates on human responses to non-lethal weapons and conducts research to assess the effects and risk of these weapons. Note: In FY 2010, this effort is broken out from the previous major thrust to separate distinct technology areas. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop initial quantitative models of behavioral responses to RFR non-lethal weapons. Develop Human Effect-Modeling Applications Program (HE-MAP) by incorporating a software interface that links graphical user interfaces with predictive models of RFR non-lethal weapon-induced effectiveness and risk. Incorporate within HE-MAP the development of a design optimization and effects-based module that will allow analysis of design parameters and their influence on effectiveness.	0.000	0.000	0.395	
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. Note: In FY 2010, this major thrust will move to Project 7184 to better align efforts. In FY 2008: Developed and validated methods to assess the viability and activity of threat agents after active countermeasures have been employed. Developed technologies that will enable the AF to locate biological warfare agents behind walls and inside of containers. Characterized organic semiconductor material interactions with directed energy to enhance agent neutralization capabilities. 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.	6.106	3.731	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research		PROJECT NUMBER 627757		
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
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. Note: In FY 2010, this major thrust will move to Project 7184 to better align efforts. In FY 2008: Developed methodologies to tailor behavioral and physiological regimens and integrate revolutionary concepts in metabolomics/human performance technologies with existing training/operations. Conducted research to quantify effects of workload distribution, task novelty, and experience on team performance in a cognitively demanding environment. 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. In FY 2010: Not Applicable.		2.064	2.042	0.000	
CONGRESSIONAL ADD: Solid Electrolyte Oxygen Separator (SEOS). In FY 2008: Conducted Congressionally-directed effort for SEOS. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		3.139	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research			PROJECT NUMBER 627757	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Ubiquitous RFID Chem/Bio Detection. In FY 2008: Conducted Congressionally-directed effort for Ubiquitous RFID Chem/Bio Detection. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.785	0.000	0.000	
CONGRESSIONAL ADD: Modeling of Aggregates of Individuals and Crowd Environments (MAICE). In FY 2008: Conducted Congressionally-directed effort for MAICE. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.569	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER 627757

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602720A/ Environmental Quality Technology.	0.000	0.000							Continuing	Continuing
PE 0603231F/ Crew Systems and Personnel Protection Technology.	0.000	0.000							Continuing	Continuing
PE 0603456F/ Human Effectiveness Adv Tech Dev.	0.000	0.000							Continuing	Continuing
PE 0604617F/ Agile Combat Support.	0.000	0.000							Continuing	Continuing
PE 0604706F/ Life Support Systems.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	217.266	252.024	196.529						Continuing	Continuing
623012: Advanced Propulsion Technology	21.133	18.006	17.568						Continuing	Continuing
623048: Combustion and Mechanical Systems	29.957	28.380	18.921						Continuing	Continuing
623066: Turbine Engine Technology	60.816	87.533	64.312						Continuing	Continuing
623145: Aerospace Power Technology	42.974	49.446	31.029						Continuing	Continuing
6233SP: Space Rocket Component Tech	52.024	58.698	0.000						Continuing	Continuing
624847: Rocket Propulsion Technology	10.362	9.961	59.101						Continuing	Continuing
625330: Aerospace Fuel Technology	0.000	0.000	5.598						Continuing	Continuing

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 seven projects, each focusing on a technology area critical to the Air Force. The Advanced Propulsion Technology develops high-speed air breathing 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 military applications that are part of the High Power Aircraft (HiPAC) program. The Rocket Propulsion Technology project develops advances in rocket propulsion technologies for space access, space maneuver, missiles, the sustainment of strategic systems and tactical rockets. Finally, the Aerospace Fuel Technology project evaluates hydrocarbon-based fuels for legacy and advanced turbine engines, scramjets, pulse detonation and combined cycle engines for missile, aircraft, high-speed vehicles, and responsive space launch vehicles.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	**R-1 ITEM NOMENCLATURE** PE 0602203F Aerospace Propulsion

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	217.172	218.049	202.683	
Current BES/President's Budget	217.266	252.024	196.529	
Total Adjustments	0.094	33.975	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.685		
Total Congressional Increases	0.000	33.060		
Total Reprogrammings	3.510	1.600		
SBIR/STTR Transfer	-3.416	0.000		

Change Summary Explanation

In FY 2009 and 2010 change in funding is due to increased emphasis on component development in support of adaptive cycle technologies, improved fuel efficiency, and highly efficient embedded turbine engines. Note: In FY 2009, Congress added $1.2M for advanced fuel cell based power system for small UAVapplications; $1.6M for advanced lithium ion battery manufacturing; $0.8M for aerospace lab equipment upgrade; $1.0M for affordable lightweight power supply development; $2.8M for development and testing of advanced paraffin-based hybrid rockets for space; $1.0M for electronics liquid cooling for advance military ground and aerospace vehicle projects; $1.6M for hybrid bearing development; $1.4M for hydrocarbon boost technology demonstrator; $2.0M for integrated aircraft energy management; $1.6M for integrated electrical starter/generator; $3.5M for integrated power for aircraft technologies (INPACTII); $2.0M for integrated propulsion analysis tool; $1.6M for lithium ion domestic materials develoment; $6.0M for manufacturing of high energy superior lithium battery technology; $0.8M for multi-mode space propulsion; $1.36M for national test facility for aerospace fuels and propulsion; $2.4M for vortex low cost rocket engine; and $0.8M for WASH oxygen sensor and cell-level battery controller. 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. Starting in FY10, Funds from Project 33SP have been moved to Project 4847 within this Program Element to more accurately align efforts.

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion					PROJECT NUMBER 623012	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
623012: Advanced Propulsion Technology	21.133	18.006	17.568						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops combined/advanced cycle air breathing 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. Efforts include modeling, simulations, and proof of concept demonstrations of critical components; advanced component development; and ground-based demonstrations.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop advanced fuel-cooled scramjet engine technologies to support flight demonstration and enable the broad application of hypersonics to meet future war fighter needs. In FY 2008: Continued development and demonstration of flight weight engine components and advanced engine control logic. Continued performing trajectory optimization for flight test. Continued 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. Initiated design and testing of advanced scramjet start techniques. Continued verification of operation of engine control techniques, based on rapid shock train identification/characterization coupled with fuel control logic, to ensure stable scramjet operation. 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. Conduct design of ground test hardware of advanced scramjet start techniques. Complete development of scramjet engine control logic for flight test engines. 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.	1.138	3.200	1.650	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion	PROJECT NUMBER 623012

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Develop and demonstrate flight weight engine components and advanced engine control logic. Perform trajectory optimization for flight test. Complete ground test of advanced scramjet start technique. Fabricate flight test hardware to demonstrate ramjet to scramjet transition.				
MAJOR THRUST: Conduct assessments, technology design trades, and simulations to integrate combined cycle engines (CCEs) and advanced cycle air breathing 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. Note: In FY 2009, efforts in this thrust were reduced due to higher AF priorities. In FY 2008: Continued trade studies to determine military payoff and establish component technology goals. Continued defining component and engine performance objectives to enable development of affordable hypersonic flight demonstrators jointly with NASA and DARPA. Continued development of advanced components for turbine-based and rocket-based CCEs. Completed testing of advanced inlets for turbine-based CCEs capable of operating from Mach 0 to Mach 8. Designed an advanced nozzle for turbine-based and rocket-based CCEs. 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. Develop advanced components for turbine-based and rocket-based CCEs. In FY 2010: Conduct trade studies to determine military payoff and establish component technology goals. Define component and engine performance objectives to enable development of affordable hypersonic flight demonstrators jointly with NASA and DARPA. Develop technology maturation plan for advanced components for turbine-based and rocket-based CCEs.	1.941	0.165	0.165	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion	PROJECT NUMBER 623012

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop robust hydrocarbon fueled scramjet engine components and technologies to improve performance, operability, durability, and scalability for future platforms. Note: Starting in FY 2008, efforts shifted towards much larger hot section testing and voluminous test data 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. Note: In FY 2009 and FY 2010, efforts in this thrust were reduced due to higher AF priorities. In FY 2008: Continued development of advanced engine components to improve scramjet operating margin and to establish scramjet scaling laws for reusable applications. Continued development of variable geometry techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Completed test of scramjet combustors 5 to 10 times baseline size for reusable applications with improved structural efficiency. Initiated development of improved durability engine concepts. Continued development of low internal drag flame stabilization devices and flight test engine components. In FY 2009: 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. Continue development of low internal drag flame stabilization devices and flight test engine components. Conduct assessment of ground test facilities and test techniques to demonstrate large (20 to 100 times) size scramjet engines. In FY 2010: Develop advanced engine components to improve scramjet operating margin and to refine scramjet scaling laws for reusable applications. Develop techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Develop low internal drag flame stabilization devices and flight test engine components. Fabricate subscale components/combustors to represent medium scale (5 to 20 times) scramjet engines.	18.054	14.641	15.753	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0601102F/ Defense Research Sciences.	0.000	0.000							Continuing	Continuing
PE 0602201F/ Aerospace Flight Dynamics.	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Tech.	0.000	0.000							Continuing	Continuing
PE 0602602F/ Conventional Munitions.	0.000	0.000							Continuing	Continuing
PE 0602702E/ Tactical Technology.	0.000	0.000							Continuing	Continuing
PE 0603211F/ Aerospace Structures.	0.000	0.000							Continuing	Continuing
PE 0603216F/ Aerospace Propulsion and Power Technology.	0.000	0.000							Continuing	Continuing
PE 0603601F/ Conventional Weapons Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ Program is reported to/ coordinated by the Joint Army/Navy/NASA/Air Force (JANNAF) Executive Committe	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been	0.000	0.000							Continuing	Continuing

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coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion					PROJECT NUMBER 623048	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
623048: Combustion and Mechanical Systems	29.957	28.380	18.921						Continuing	Continuing

Note

Note: The fuels portion of this Project will be moved to Project 5330 within this Program Element from FY 2010 to more accurately align efforts with organizational structure.

A. Mission Description and Budget Item Justification

This project evaluates fuels, lubricants, mechanical systems, and combustion concepts for advanced turbine engines, scramjets, pulsed detonation, and combined cycle engines. This project also develops technologies 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, detonations, combustors and afterburners. 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. The fuels portion of this BPAC will be moved to Project 5330 in FY 2010 to more accurately align efforts with organizational structure.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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 adaptive cycle engine architecture. Design, fabricate, and test of key thermal management technologies. In FY 2008: Conducted 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. Continued effort to validate component performance models on aircraft thermal management simulator. Completed the development of approaches to assess and improve additive combustion behavior at low fuel and air temperatures. Tested fuel candidates in bench scale rigs simulating advanced high Mach propulsion systems and the Highly Efficient Embedded Efficient Turbine Engine (HEETE).	2.880	3.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Developed a robust mechanical and integrated engine thermal management system (mechanical and fuel systems) for optimum engine performance and durability at sustained supersonic cruise conditions. In FY 2009: Conduct 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. Test fuel candidates in bench scale rigs simulating advanced high Mach propulsion systems and the HEETE. 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. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop advanced additive approaches to reduce engine emissions and signature (including nano-scale additives), as well as advanced emission diagnostic test protocols. In FY 2008: Completed assessing novel fuel additives including nano-technologies to reduce emissions in laboratory scale combustion rigs. Initiated improvement of combustion models for kerosene fuels. Continued higher-pressure measurements of additive and fuel effects on sub-micron particulate generation during combustion. 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. Improve combustion models for kerosene fuels. In FY 2010: Not Applicable.		1.000	1.000	0.000	
		1.000	1.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Expanded investigation of the performance of alternative fuels to include bio-derived fuels. Initiated development of bioreactors to simulate biological growth in aircraft fuel systems and ground storage facilities. Initiated development of knowledge base for certification of Fischer-Tropsch fuels for all Air Force tactical vehicles. Evaluated advanced nano-technology fuel sensors, nano-technology fuel additives, and novel detection and mitigation technologies for biological growth. In FY 2009: Expand investigation of performance of biomass-derived fuels for aircraft and other field hardware. Extend knowledge base to other alternative fuels, such as those derived from biomass. Develop bioreactors to simulate biological growth in aircraft fuel systems and ground storage facilities. Expand knowledge base for certification of Fischer-Tropsch fuels for all Air Force tactical vehicles. In FY 2010: Not Applicable.				
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. In FY 2008: Completed study of refined kerosene propellants under high heat flux conditions and studied synthesized high-energy hydrocarbons. Improve fuel property database and share with industry to improve design tools. In FY 2009: Expand study of high-energy hydrocarbon propellant candidates. Complete improved physical property database for kerosene propellants at high pressure. Collect improved physical property for high energy hydrocarbons and improve physical property models. In FY 2010: Not Applicable.	0.500	0.500	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop, test, and evaluate revolutionary combustion and propulsion concepts for gas turbine, pulsed detonation, and combined cycle engines for missiles, manned and unmanned systems, and reusable 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. In FY 2008: Demonstrated small-scale inter-turbine burner (ITB) concepts in a relevant engine environment. Investigated the scalability of inter-turbine burners for large engines. Assessed an integrated pulsed detonation/ hybrid turbine concept performance with component fabrication and evaluation. Investigated combustor and augmentor systems for high-altitude low-high mach applications. Evaluated and optimized advanced combustor, augmentor, and pulsed detonation engine (PDE) concepts using modeling and simulation tools. In FY 2009: Evaluate advanced combustion system performance at realistic operating conditions. Demonstrate small-scale ITB concepts in small engines. Identify concept designs of inter-turbine burning concepts for large gas turbine engines. Optimize component efficiency of the integrated pulsed detonation/hybrid turbine. Evaluate and optimize advanced combustor, augmentor, and PDE concepts using modeling and simulation tools covering wider flight conditions and applications. In FY 2010: Test concept designs for larger-scale inter-turbine burners at relevant gas turbine engine conditions. Evaluate performance characteristics in small engines burning military fuels. Identify potential performance improvements for small engines. Investigate novel combustor, augmentor and pulse-detonation concepts that reduce fuel burn and improve system performance. Study combustion processes using alternative fuels. Develop new chemistry models for combustion processes. Employ modeling and simulation tools to evaluate advanced combustion systems. Investigate high-efficiency direct injection methods for PDE's.		4.576	7.493	7.180	
MAJOR THRUST: Develop approaches to extend the life of endothermic fuels and fuel system components for sustained supersonic and reusable hypersonic cruise applications.		0.500	0.500	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Evaluated improved coke-mitigating surfaces/catalysts with 2nd generation endothermic fuels in bench-scale heat exchanger rigs. Assessed unconventional approaches to increase fuel heat sink and minimize regenerative cooling heat loads in panel tests. Initiated study of relationship between fuel structure/ properties and combustion behavior including blowout. In FY 2009: Conduct bench-scale tests to evaluate improved surfaces/catalysts for 2nd generation endothermic fuels. Assess unconventional approaches to increase fuel heat sink and minimize regenerative cooling heat loads. Study relationship between fuel structure/properties and combustion behavior including blowout. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for application to revolutionary propulsion technologies. In FY 2008: Demonstrated high-bandwidth (e.g., MHz-rate) planar laser-induced fluorescence for high-speed digital imaging of key combustion species in fundamental laboratory flames and relevant engine environments. Applied terahertz radiation (T-rays) for combustion temperature sensing and non-destructive inspection/ evaluation of turbine engine components. Integrated current and next-generation combustion diagnostics to support RDT&E of augmentor solutions for fighter aircraft. In FY 2009: Develop high-speed techniques for measuring carbon monoxide (CO) to evaluate CO oxidiation/ combustion efficiency in near constant volume combuston 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. Develop ultrafast (picosecond, femtosecond) coherent anti-Stokes Raman scattering (CARS) for measuring temperature and critical species in combustion devices. Apply advanced optical diagnostics suites to characterization and improvement of engine combustors and afterburners.		1.000	1.000	1.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Develop MHz-rate high-speed measurement techniques for combustion species. Use two-color planar laser-induced fluorescence techniques to measure temperature in experimental combustion systems. Develop robust line-of-sight measurement techniques for temperature and species and apply to relevant combustion devices. Apply ultrafast CARS techniques developed in FY2009 to practical combustion devices and engine systems. Apply advanced optical diagnostics suites to characterization and improvement of engine combustors and afterburners.					
MAJOR THRUST: Develop, test, and qualify advanced turbine engine lubricants. 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 conducted field support activities for aviation lubrication technologies and DoD operational units. In FY 2008: Completed qualification testing of two enhanced 5cSt ester candidates, transitioned to demo engine program and draft new oil specification. Ramped up qualification testing of hi-mach 7cSt ester in preparation of engine demo. Developed an integrated and effective bearing/oil health monitoring system with prognostics capability to address critical DoD safety, readiness, and life-cycle cost concerns. Conducted preliminary technology assessment of long-term, low-temperature (hi-altitude) performance of engine lubricants and initiated concepts for efficient mechanical system for highly efficient embedded turbine engines. In FY 2009: Demonstrate enhanced 5cSt ester lubricant in JSF thrust growth demo engines. Finalize new enhanced 5cSt oil specification. Initial 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 and adaptive versatile turbine engines (ADVENT). Continue development of high-temperature lubricants for Long Range Strike aircraft. In FY 2010: Publish enhanced ester oil specification and support transition activities to fighter aircraft. Conduct component level testing of hi-Mach ester lubricant for future Long Rang Strike (LRS) aircraft. Develop intelligent prognostics for lubrication system health monitoring.		2.600	5.435	5.241	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop and test advanced bearing material technology and bearing concepts for small, intermediate, and large-sized turbine engine applications. In FY 2008: Conducted subscale fatigue life and spall propagation studies of bearing materials with enhanced ester 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 HEETE. In FY 2009: Continue sub-scale fatigue life and spall propagation studies of bearing materials and validate spall propagation models with oil candidates and begin full-scale tests. Conduct full-scale bearing evaluation to map out and transfer thermal models in support of ADVENT. In FY 2010: Test bearing concepts for high Mach missile and other future applications.		2.600	5.500	5.500	
CONGRESSIONAL ADD: Hybrid Bearings. In FY 2008: Successfully demonstrated hybrid bearing for the F135 core thrust bearing in rig tests and over two hundred hours of operation in F135 SDD engine test. Developed critical flaw size for Non Destructive Evaluation of ceramic rolling elements. Initiated bearing cage evaluation program. In FY 2009: Complete fabrication on, and endurance test, full-scale 2nd Gen P675 hybrid bearings for transition into P&Ws F135 engine in 2010. Continue towards demonstrating and quantifying the performance benefits of light-weight composite bearing cages thru full-scale bearing testing. In FY 2010: Not Applicable.		2.347	1.596	0.000	
CONGRESSIONAL ADD: Alternative Energy Research.		9.781	0.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Performed research on alternative energy, focusing on alternative hydrocarbon based aviation fuels made from coal, biomass, and oil shale. Research included fuel property evaluation and enhancement, as well as component and engine testing of alternative fuels and fuel blends. In FY 2009: Not Applicable. In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: WASH Oxygen Sensor and Cell Level Battery Controller. In FY 2008: Developed oxygen sensors for aircraft wing tanks to help prevent risk of explosion. Developed a Smart Battery Module (SBM) for use with the Harris Manpack Radio Set (AN/PRC-117G). Prepared a demonstration of a large scale SBM to verify the scalability and performance of the system. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	1.173	0.000	0.000	
CONGRESSIONAL ADD: National Test Facility for Aerospace Fuels and Propulsion In FY 2008: Not Applicable. In FY 2009: Upgrade eductional facilities at Purdue that are part of the "National Test Facility for Aerospace Fuels and Propulsion". In FY 2010: Not Applicable.	0.000	1.356	0.000	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0601102F/ Defense Research Sciences.	0.000	0.000							Continuing	Continuing
PE 0602805F/ Dual Use Science and Technology.	0.000	0.000							Continuing	Continuing
PE 0603216F/ Aerospace Propulsion and Power Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
623066: Turbine Engine Technology	60.816	87.533	64.312						Continuing	Continuing

Note

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.

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 agency and industry effort 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 war-fighting, tactical and global mobility, responsive space lift, and persistent Intelligence, Surveillance, and Reconnaissance (ISR). 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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 and evaluate 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. In FY 2008: Continued to develop and apply advanced modeling and simulation rules and tools for advanced components. Developed and optimized novel dual fuel burner. Determined suitability of latest Titanium	34.903	65.204	46.284	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Aluminide materials for Mach 4 compressor application. Developed and applied advanced modeling and simulation rules and tools to significantly improve component efficiencies, enabling reduced fuel consumption in emerging and future gas turbine propulsion systems. Developed and applied advanced modeling and simulation rules and tools to initiate definition and design of lightweight, simple, adaptive cycle features. Developed and applied advanced modeling and simulation rules and tools to initiate definition and design of an efficient, wide-flow range compressor. Initiated 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. Developed and applied 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 Specific Fuel Consumption (SFC). In FY 2009: 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. 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. In FY 2010: Develop and apply advanced modeling and simulation rules and tools for advanced components. Develop computational fluid dynamics methodology for analyzing turbine flows. Develop CMC lifing models. Conduct bench and rig tests for validation of components with significantly improved efficiency. 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. Rig test efficient, very high pressure ratio compressor and associated thermal management features that will offer a step change improvement in engine Specific Fuel Consumption (SFC.)				

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2008: Continued to develop and apply advanced modeling and simulation rules and tools for advanced components. Conducted risk reduction testing of variable bypass ratio fan concept. Developed and rig tested reheat augmentor technology to significantly decrease burning length. Designed and fabricated an advanced lightweight, variable area exhaust nozzle. In FY 2009: 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. Conduct rig testing of advanced low pressure turbine design for application to a variable cycle engine concept. Design and rig test lightweight, simple, LO-compatible inlet and exhaust system. In FY 2010: 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. Conduct rig testing of advanced low pressure turbine design for application to a variable cycle engine concept. Rig test of lightweight, simple, LO-compatible inlet and exhaust system.		13.936	15.773	15.773	
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. Note: In FY 2010, efforts in this thrust were reduced due to higher AF priorities. In FY 2008: Utilized 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.		4.536	5.246	0.945	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2010: Develop and apply advanced modeling and simulation rules and tools for advanced limited life components. Design and rig test advanced limited life components.					
MAJOR THRUST: Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports. In FY 2008: Developed new and innovative design concepts and conduct bench and rig tests for validation of a mixed flow turbine design. In FY 2009: Utilize data from efficient small scale engine testing of an advanced forward swept, centrifugal compressor, and a silicon nitride mixed flow turbine to update and validate advanced modeling and simulation rules and tools. In FY 2010: Develop and apply advanced modeling and simulation rules and tools for advanced limited life components.		2.453	1.310	1.310	
CONGRESSIONAL ADD: Active Combustion Control System for Military Aircraft. In FY 2008: Conducted research and development on active combustion control systems In FY 2009: Not Applicable. In FY 2010: Not Applicable.		3.423	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: VDVP for UAV/UCAV Aircraft Engines. In FY 2008: Conducted research and development on variable displacement vane pumps for UAV and UCAV engines. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	1.565	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion	PROJECT NUMBER 623066

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Materials:	0.000	0.000							Continuing	Continuing
PE 0601102F/ Defense Research Sciences.	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0603216F/ Aerospace Propulsion and Power Technology.	0.000	0.000							Continuing	Continuing
PE 0602122N/ Aircraft Technology.	0.000	0.000							Continuing	Continuing
PE 0603210N/ Aircraft Propulsion.	0.000	0.000							Continuing	Continuing
PE 0603003A/ Aviation Advanced Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion					PROJECT NUMBER 623145	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
623145: Aerospace Power Technology	42.974	49.446	31.029						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Developed and designed efficient, high power, high temperature power electrical components. Developed and tested air vehicle electromagnetic and radio frequency effects immune components. Designed and fabricated thermal management components and subsystems. Conducted studies, modeling and simulation, and developed preliminary designs for energy harvesting and energy dense, long endurance battery, and fuel cell components and subsystems. Developed and tested rechargeable/refuelable, lightweight, energy dense, high power hybrid battery, fuel cell and power management components and subsystems. In FY 2009: Fabricate, integrate, and test high efficiency, high power, wide temperature range power electrical components. Initiate integration and test air vehicle electromagnetic and radio frequency effects immune components. Integrate and test thermal management components and subsystems.	27.222	23.763	25.751	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification			DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 623145	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Assess component performance objectives needed to meet systems level, energy optimized performance goals. Develop integrated modeling with hardware-in-the-loop simulation test capability for power and thermal management components and subsystems.					
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. Note: In FY 2009-11, this thrust is reduced due to higher AF priorities. In FY 2008: Developed and initiated design of a flight-weight superconducting generator, high rate charge/ discharge energy storage and high voltage/current components and subsystems. Developed concept designs for superconducting multimegawatt generator. In FY 2009: Investigate high-rate thermal energy storage for directed energy applications. In FY 2010: Complete investigation of high-rate thermal energy storage for directed energy applications. Develop preliminary design of power and thermal management system for high energy laser flight demonstration.		2.353	1.398	1.119	
MAJOR THRUST: Develop hybrid electrical power and thermal management, including energy conversion/ storage, components and subsystem technologies for special purpose applications enabling long endurance missions. Note: In FY 2009, efforts in this thrust are broken out from previous thrust to better address increased emphasis on component development in support of electric hybrid special programs. In FY 2008: Not applicable. In FY 2009: 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.		0.000	4.039	4.159	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification			DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 623145	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Investigate and develop hybrid energy harvesting storage, management and distribution architectures. Integrate the energy harvesting technologies with novel battery and fuel cell technologies. Integrate and test thermal management components and subsystems. Implement methods of energy harvesting and increased energy savings for special purpose applications. Demonstrate long endurance flight tests of integrated systems for unmanned aerial systems.					
CONGRESSIONAL ADD: Integrated Electrical Starter/Generator. In FY 2008: Completed detailed design and developed lightweight, compact, high temperature starter generator and Inverter-Converter Controllers (ICCs) to increase the technology readiness level (TRL). In FY 2009: Further develop starter/generator architecture for an advanced regenerative energy capable electrical power system. Special emphasis on overall thermal systems management. Integrated electrical and thermal management system will be tested in the Boeing Facility for Integration and Research of Subsystems Technologies (FIRST) Lab. In FY 2010: Not Applicable.		1.957	1.596	0.000	
CONGRESSIONAL ADD: Manufacturing of High Energy Superior Lithium Battery Technology. In FY 2008: Developed and designed equipment and processes for domestic production of SLPB batteries and developed appropriate anode, cathode and electrolyte materials for prototype production of cells and batteries. In FY 2009: Continue development and design of equipment and processes for domestic production of SLPB batteries and developed appropriate anode, cathode and electrolyte materials for prototype production of cells and batteries. In FY 2010: Not Applicable.		5.868	5.983	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 623145	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Advanced Fuel Cell Based Power System for Small UAVs In FY 2008: Developed power systems for small/micro UAV systems. Examined mirco UAV systems requirements to determine the size, weight and power requirements needed to power these small aircraft. Performed feasibility studies and developed initial design of fuel cell systems to meet specifications resulting from the requirements study. In FY 2009: Improve power systems for small/micro UAV systems. Narrow mirco UAV systems requirements to determine the size, weight and power requirements needed to power these small aircraft. Extend feasibility studies and developed initial design of fuel cell systems to meet specifications resulting from the requirements study. In FY 2010: Not Applicable.		0.783	1.197	0.000	
CONGRESSIONAL ADD: Modified F-22 MaintenanceMaintneance-Free Nickel Cadmium Aircraft Batteries for the F-16. In FY 2008: Developed modifications of the cell designs, materials and electronics in the F-22 sealed Nickel-Cadmium battery for application in the F-16 aircraft. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.369	0.000	0.000	
CONGRESSIONAL ADD: Thermal and Energy Management for Aerospace (THEMA).		3.422	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 623145	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Conducted research to advance the state of the art of thermal and energy management technologies for aerospace applications. In FY 2009: Not Applicable. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Advanced Lithium Ion Battery Manufacturing In FY 2008: Not Applicable. In FY 2009: Develop solid state rechargeable lithium batteries for very high power and energy densities and long cycle life. In FY 2010: Not Applicable.		0.000	1.596	0.000	
CONGRESSIONAL ADD: Affordable Lightweight Power Supply Development In FY 2008: Not Applicable. In FY 2009: Develop alternative high performance electrolytes and low-cost membrane electrode assemblies (MEAs), 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. In FY 2010: Not Applicable.		0.000	0.997	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 623145	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Electronics Liquid Cooling For Advanced Military Ground and Aerospace Vehicle Projects In FY 2008: Not Applicable. In FY 2009: Develop cost-effective production methods and certified processes for implementing advanced liquid cooling technologies military ground and air platform power electronics and related embedded computing applications. In FY 2010: Not Applicable.		0.000	0.997	0.000	
CONGRESSIONAL ADD: Integrated Aircraft Energy Management In FY 2008: Not Applicable. In FY 2009: Use advanced modeling and simulation techniques to identify vehicle level thermal management issues and identify potential solutions. In FY 2010: Not Applicable.		0.000	1.995	0.000	
CONGRESSIONAL ADD: Integrated Power for Aircraft Technologies (INPACT II) In FY 2008: Not Applicable. In FY 2009: Develop technologies for increased efficiency in energy utilization, improved thermal management techniques and more effective energy management of systems and subsystems to enable meeting performance objective for future military aircraft.		0.000	3.491	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 623145	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Lithium Ion Domestic Materials Development In FY 2008: Not Applicable. In FY 2009: Research and development on synthesis of cathode materials for lithium ion batteries. In FY 2010: Not Applicable.		0.000	1.596	0.000	
CONGRESSIONAL ADD: WASH Oxygen Sensor and Cell Level Battery Controller In FY 2008: Not Applicable. In FY 2009: Develop technology that will monitor the state-of-heath (SOH) and state-of-charge (SOC) of each individual cell of a multicelled battery for the purpose of preventing over or under-charge of individual cells. Develop an O2 sensor for fuel tank inerting applications with specific customers such as the C-17 Support Group. In FY 2010: Not Applicable.		0.000	0.798	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion	PROJECT NUMBER 623145

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0601102F/ Defense Research Sciences.	0.000	0.000							Continuing	Continuing
PE 0602102F/ Aerospace Flight Dynamics.	0.000	0.000							Continuing	Continuing
PE 0602605F/ Directed Energy Technology.	0.000	0.000							Continuing	Continuing
PE 0602805F/ Dual Use Science and Technology.	0.000	0.000							Continuing	Continuing
PE 0603605F/ Advanced Weapon Technology.	0.000	0.000							Continuing	Continuing
PE 0603216F/ Aerospace Propulsion and Power Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion					PROJECT NUMBER 6233SP	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
6233SP: Space Rocket Component Tech	52.024	58.698	0.000						Continuing	Continuing

Note

Note: In FY10, work was moved to PE 0602203F Project 4847 to more accurately align efforts.

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), 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. 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. In FY10, work was moved to PE 0602203F Project 4847 to more accurately align efforts.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Evaluatd and developed potential hydrocarbon fuel additives to improve performance of kerosene. Began downselect and scale-up promising high energy-density materials candidates. Completed efforts at development and characterization of high nitrogen ingredients. Evaluated scaled-up propellants in advanced combustion devices to determine materials compatibility and performance to include supporting large-scale	4.086	4.441	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 6233SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
motor tests. Explored and developed ionic liquids meeting IHPRPT Phase III goals. Initiated scale up of promising ionic liquids for further characterization. Conducted proof of concept for new computational code to predict molecular properties. 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. In FY 2010: Not Applicable.					
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 aero-vehicles and potential launch systems. In FY 2008: Characterized, studied, and evaluated shear coaxial injector performance to ensure chamber/ injector compatibility and prevent damage to upper stage engines. Developed, analyzed, and transitioned advanced combustion device technology, including injectors and chambers suitable for advanced synthetic hydrocarbon fuels capable of meeting or exceeding the Phase III goals. Developed 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. Completed scale-up and transition new energetic advanced hydrocarbon fuels and additives for rocket propulsion, including space storable high energy, non-toxic fuels. Conducted validation and verification of advanced multi-phase M&S capabilities. Performed pre-selection of most promising advanced propulsion concepts; apply realistic		8.285	8.501	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 6233SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
computational models to optimize performance. Continued and refined experimental demonstrations of proof-of-concepts, continue development of realistic computational models. Continued system trade studies with improved performance models to evaluate potential return on investment. 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 IHPRPT 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. 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. Refine experimental demonstrations of proof-of-concepts, continue development of realistic computational models. Conduct system trade studies with improved performance models to evaluate potential return on investment. In FY 2010: Not Applicable.					
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. In FY 2008: Continued developing new advanced ablative components using hybrid polymers. Continued to characterize and finalize processing parameters of new nano-reinforced high temperature polymers and scale-up processing of carbon-carbon materials. Continued developing new advanced materials for use with high-energy propellants. Continued to explore using nanocomposites for liquid rocket engine components and optimize processing technology using multifunctional nanomaterials. Evaluated new class of hydrophobic and oleophobic materials.		5.903	6.507	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 6233SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Develop new advanced ablative components using hybrid polymers. Characterize and finalize processing parameters of new nano-reinforced high temperature polymers and scale-up processing of carbon-carbon materials. Develop new advanced materials for use with high-energy propellants. Explore using nanocomposites for liquid rocket engine components and optimize processing technology using multifunctional nanomaterials. Characterize and understand the mechanisms behind a new class of hydrophobic and oleophobic materials. In FY 2010: Not Applicable.					
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. In FY 2008: Completed advanced modeling and simulation tool development for advanced cryogenic liquid rocket upper stage technologies. Continued enabling hydrocarbon boost technology development for future spacelift concepts. Initiated engine health monitoring effort supporting the hydrocarbon boost technology development effort. Also initiated Phase III efforts developing hydrocarbon engine technologies using fuels other than kerosene. 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 IHPRPT Phase III goals. In FY 2010: Not Applicable.		21.843	22.947	0.000	
MAJOR THRUST: Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for station-keeping, repositioning, and orbit transfer for large communication satellites, micro-satellites, and satellite constellations.		5.061	5.731	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 6233SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Continued Hall thruster Phase III development efforts. Continued evaluating Phase III plasma thrusters for microsatellites propulsion systems. Continued scale-up testing Phase II and III monopropellants. Continued assessment of advanced chemical propulsion technology developments for satellite thrusters. Continued development of advanced multi-mode chemical-electric propulsion concepts for satellites. Initiated development of alternative propulsion concepts and associated modeling, simulation, and analysis tools to augment or replace Hall Thrusters in the future. In FY 2009: Conduct Hall thruster IHPRPT Phase III development efforts. Evaluate IHPRPT Phase III plasma thrusters for microsatellites propulsion systems. Scale-up testing IHPRPT Phase II and III monopropellants, evaluate advanced ignition schemes and chamber concepts. Assess advanced chemical propulsion technology developments for satellite thrusters, begin component developments. Develop advanced multi-mode chemical-electric propulsion concepts for satellites, down-select to single design concept and begin component developments. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Advanced Vehicle and Propulsion Center. In FY 2008: Refined analytical tools to help assess feasibility and cost benefit of using "common" boosters/ engines across multiple launch platforms. Conducted model developments that will support Prompt Global Strike, future ballistic missile development efforts, and other missile/boost concepts. In FY 2009: Refinement of analytical tools helping assess feasibility and cost benefit of using "common" boosters/engines across multiple launch platforms. Continue model developments that will support Prompt Global Strike, future ballistic missile development efforts, and other missile/boost concepts. In FY 2010: Not Applicable.		1.564	1.197	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 6233SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Hydrocarbon Boost Technology Demonstrator. In FY 2008: Accelerated development of technologies for highly operable and reusable spacelift. In FY 2009: Conduct additional modeling, simulation, and analysis work for liquid rocket engines which will make them more affordable, operable, and reliable. In FY 2010: Not Applicable.		1.174	1.396	0.000	
CONGRESSIONAL ADD: Development & Testing of Advanced Paraffin Based Hybrid Rockets for Space Applications. In FY 2008: Scaled up hybrid rocket technologies and characterized for potential use in space applications. In FY 2009: Continue to scale-up motors. Design, build and initiate testing of 24 inch diameter, 30,000 pound thrust-class motors. In FY 2010: Not Applicable.		1.564	2.792	0.000	
CONGRESSIONAL ADD: Integrated Propulsion Analysis Tool (IPAT) In FY 2008: Increased fidelity of rocket engine analysis and assessment tools and broaden application to advanced concepts being considered by the Air Force. In FY 2009: Increase fidelity of rocket engine analysis and assessment tools and broaden application to advanced concepts being considered by the Air Force.		1.564	1.995	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 6233SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: LOX/Methane Cooled Upper Stage Rocket Engine. In FY 2008: Scaled-up liquid oxygen, liquid methane pressure fed second stage rocket engine technologies for the Air Force. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.980	0.000	0.000	
CONGRESSIONAL ADD: Multi-Mode Space Propulsion In FY 2008: Not Applicable. In FY 2009: Provide added risk reduction efforts to existing scope of work developing multi-mode propulsion technology. In FY 2010: Not Applicable.		0.000	0.798	0.000	
CONGRESSIONAL ADD: Vortex Low Cost Rocket Engine In FY 2008: Not Applicable.		0.000	2.393	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion	PROJECT NUMBER 6233SP

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Develop small launch vehicle that utilizes vortex combustion processes to generate improved performance and/or operability. In FY 2010: Not Applicable.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/Not Applicable.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion					PROJECT NUMBER 624847	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
624847: Rocket Propulsion Technology	10.362	9.961	59.101						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops rocket propulsion technologies for space access, space maneuver, missiles, the sustainment of strategic systems (including solid boost/ missile propulsion, post boost control, aging and surveillance efforts), and tactical missiles. Analytical and experimental areas of emphasis are propellants, propellant management, combustion, rocket material applications, Technology for Sustainment of Strategic Systems (TSSS), and novel space propulsion concepts. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of these systems. Technologies are developed to reduce the weight and cost of components using new materials and improved designs and manufacturing techniques. All efforts in this project contribute to the Technology for the Sustainment of Strategic Systems (TSSS) program and 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. 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. Aging and surveillance efforts could reduce lifetime prediction uncertainties for individual motors by 50 percent, enabling motor replacement for cause. Note: In FY 2010, funds from Project 33SP have been moved to Project 4847 within this Program Element to more accurately align efforts.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. Note: In FY 2008 and FY 2009 this work was conducted under project 33SP. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	0.000	0.000	4.689	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 624847	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Evaluate and develop potential hydrocarbon fuel additives to improve performance of kerosene. Proceed with downselect and scale-up promising high energy-density materials candidates. Evaluate scaled-up propellants in advanced combustion devices to determine materials compatibility and performance to include supporting large-scale motor tests. Explore and develop ionic liquids meeting IHPRPT Phase III goals. Initiate scale up of promising ionic liquids for further characterization. Conduct proof of concept for new computational code to predict molecular properties of promising propellant ingredients.					
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 aero-vehicles and potential launch systems. Note: In FY 2008 and FY 2009 this work was conducted under project 33SP. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Characterize, study, and evaluate shear injector performance to ensure chamber/injector compatibility and prevent damage to engines. Development, analysis, and transition of advanced combustion device technology, including injectors and chambers capable of meeting or exceeding the IHPRPT 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. 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. Refine experimental demonstrations of proof-of-concepts, continue development of realistic computational models. Conduct system trade studies with improved performance models to evaluate potential return on investment.		0.000	0.000	8.401	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 624847	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. Note: In FY 2008 and FY 2009 this work was conducted under project 33SP. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop new advanced ablative components using hybrid polymers. Characterize and finalize processing parameters of new nano-reinforced high temperature polymers and scale-up processing of carbon-carbon materials. Develop new advanced materials for use with high-energy propellants. Explore using nanocomposites for liquid rocket engine components and optimize processing technology using multifunctional nanomaterials. Characterize and understand the mechanisms behind a new class of hydrophobic and oleophobic materials exploring various transition opportunities.		0.000	0.000	6.698	
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. Note: In FY 2008 and FY 2009 this work was conducted under project 33SP. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Update advanced modeling, simulation, and analysis tools with results from full-scale component testing. Develop enabling hydrocarbon boost technology 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 IHPRPT Phase III goals.		0.000	0.000	21.884	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 624847	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for station-keeping, repositioning, and orbit transfer for large communication satellites, micro-satellites, and satellite constellations. Note: In FY 2008 and FY 2009 this work was conducted under project 33SP. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Conduct Hall thruster IHPRPT Phase III development efforts. Evaluate IHPRPT Phase III plasma thrusters for microsatellites propulsion systems. Scale-up testing IHPRPT Phase II and III monopropellants, evaluate advanced ignition schemes and chamber concepts. Assess advanced chemical propulsion technology developments for satellite thrusters, continue component developments. Develop advanced multi-mode chemical-electric propulsion concepts for satellites, continue component developments. Development of next generation high power spacecraft propulsion.		0.000	0.000	6.976	
MAJOR THRUST: Develop missile propulsion and boost technologies. Efforts support the Technology for the Sustainment of Strategic Systems (TSSS) program. In FY 2008: Conducted component development and risk reduction efforts for TSSS Phase II Missile Propulsion demonstration. Conducted sub-scale testing of 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. Completed modeling, simulation, and analysis tool development efforts. Continued development of advanced tactical propulsion technologies. In FY 2009: Conduct component development and risk reduction efforts for TSSS Phase II Missile Propulsion demonstration. Use physics based modeling, simulation, and analysis tools to design and analyze sub-scale components to help verify suitability of those technologies for use in TSSS Phase II Missile Propulsion		8.245	6.050	7.102	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 624847	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
demonstration. Verify development of rapid densification nozzle technology using improved strategic propellants for future ballistic missiles to enhance performance and weight. Demonstrate low-cost, high temperature, non-erosive, lightweight coated carbon-carbon, ceramic and hybrid polymer components for solid rocket motors. Development of advanced tactical propulsion technologies. In FY 2010: Conduct component development and risk reduction efforts for TSSS Phase II Missile Propulsion demonstration. Use physics based modeling, simulation, and analysis tools to design and analyze sub-scale components to help verify suitability of those technologies for use in TSSS 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. Demonstrate low-cost, high temperature, non-erosive, lightweight coated carbon-carbon, ceramic, and hybrid polymer components for solid rocket motors. Development of advanced tactical propulsion technologies. Evaluate next generation of updated, physics-based modeling, simulation, and analysis tools for missile propulsion components and applications.					
MAJOR THRUST: Develop missile propulsion technologies and aging and surveillance technologies for ballistic missiles. Efforts support the Technology for the Sustainment of Strategic Systems (TSSS) program. In FY 2008: Continued advanced service life prediction technology program. Developed and applied existing and advanced sensors to be attached to solid rocket motors, and tools that can integrate sensor data into existing aging and surveillance tool suite. In FY 2009: Conduct advanced service life prediction technology program. Develop and apply existing and advanced sensors to be attached to solid rocket motors, and tools that can integrate 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. Assess next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, non-destructive analysis tools.		2.117	3.113	3.351	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion	PROJECT NUMBER 624847

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Conduct advanced service life prediction technology program. Develop and apply existing and advanced sensors to be attached to solid rocket motors, and tools that can integrate sensor data into existing aging and surveillance tool suite. Assess integrating advanced aging and surveillance technologies into demonstrations to validate and verify efforts to reduce uncertainties and accurately model motor behavior. Develop next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, non-destructive analysis tools.				
CONGRESSIONAL ADD: Aerospace Lab Equipment Upgrade In FY 2008: Not Applicable. In FY 2009: Purchase equipment for university use in classroom instruction and research efforts. In FY 2010: Not Applicable.	0.000	0.798	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion	PROJECT NUMBER 624847

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0601102F/ Defense Research Sciences.	0.000	0.000							Continuing	Continuing
PE 0602114N/ Power Projection Applied Research.	0.000	0.000							Continuing	Continuing
PE 0602303A/ Missile Technology.	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Tech.	0.000	0.000							Continuing	Continuing
PE 0603311F/ Ballistic Missile Technology.	0.000	0.000							Continuing	Continuing
PE 0603401F/ Advanced Spacecraft Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion					PROJECT NUMBER 625330	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
625330: Aerospace Fuel Technology	0.000	0.000	5.598						Continuing	Continuing

Note

Note: The funding in this project will be transferred in from 62203F Project 3048 starting in FY 2010 to more accurately align efforts with organizational structure.

A. Mission Description and Budget Item Justification

This project evaluates hydrocarbon-based fuels for legacy and advanced turbine engines, scramjets, pulse detonation and combined cycle engines. This project also considers fuel related concepts that can increase turbine engine operational reliability, durability, mission flexibility, energy efficiency, 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 evaluations of fuel properties and characteristics of alternative fuels developed from unconventional sources (such as coal, natural gas, biomass, and combinations thereof), fuels and components used in integrated thermal and energy management systems including high heat sink fuel capability, fuels logistics and associated vulnerabilities, and combustion diagnostics and engine emissions measurements.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Conduct research and perform technical assessments of alternative hydrocarbon fuels for use in legacy and advanced aerospace systems. Alternative fuels include those derived from coal, natural gas, biomass and combinations thereof. Efforts include investigation of the chemical composition, evaluation of fuel properties, and fuel "fit-for-purpose" assessments of potential alternative aviation fuels. Develop an understanding of alternative aviation fuel lifecycle green house gas emissions relative to conventional petroleum and evaluate potential mitigation approaches. Note: Funding in FY 2010 will be transfered from Project 3048. In FY 2008: Not Applicable. In FY 2009: Not Applicable In FY 2010: Complete component evaluations of 50% synthetic paraffinic kerosene (SPK) produced by Fischer-Tropsch synthesis blended with 50% conventional aviation fuel. Conduct component "fit-for-purpose"	0.000	0.000	2.915	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 625330	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
evaluations of up to 100% SPK. Conduct initial evaluations of biomass derived aviation fuels, both blended with conventional aviation fuel and used 100%. Assess analytical tools being developed to assess CO2 footprint of coal and biomass derived alternative fuels.					
MAJOR THRUST: Develop and demonstrate advanced components and conduct performance assessments of advanced aircraft integrated thermal and energy management systems for advanced engines, aircraft, and combined cycle systems. Develop analytical tools necessary to conduct performance assessments. Develop understanding of and investigate methods to improve the properties and characteristics of current and future aerospace fuels used in integrated thermal and energy management systems. Note: Funding in FY 2010 will be transfered from Project 3048. In FY 2008: Not Applicable. In FY 2009: Not Applicable In FY 2010: Assess advanced aircraft thermal management designs. Develop and assess techniques to improve the thermal characteristics of aviation fuels used in integrated thermal and energy management systems. Develop advanced hydrocarbon based endothermic fuel technologies applicable to combined cycle engines.		0.000	0.000	0.800	
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). Assess fuel logistics vulnerabilities (biological and chemical) and develop detection and mitigation technologies. Note: Funding in FY 2010 will be transfered from Project 3048. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		0.000	0.000	1.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion			PROJECT NUMBER 625330	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Assess aberrant logistical fuels to support field operations and recommend possible corrective actions. Evaluate low cost fuel additives and assess the impact on biological growth in fuel. Complete the development of experimental systems to simulate biological contamination in aircraft fuel systems and ground storage facilities and investigate possible mitigation actions.					
MAJOR THRUST: Develop and test advanced emissions diagnostic techniques for legacy and advanced airbreathing propulsion systems. Conduct evaluations of the combustion and emissions characteristics of current aviation fuels, alternative aerospace fuels, fuel additives, and combinations thereof in representative combustion systems. Note: Funding in FY 2010 will be transfered from Project 3048. In FY 2008: Not Applicable In FY 2009: Not Applicable. In FY 2010: Complete combustion emissions evaluations of high pressure combustor sectors operating on 100% pure and blends of synthetic paraffinic kerosene with conventional aviation fuel and compare to analytical predictions. Develop diagnostic protocols for aircraft ground emissions measurements and perform emissions evaluations on fielded engines to investigate particulate formation and composition. Initiate development of emissions diagnostics applicable to advanced high pressure combustor systems. Conduct preliminary assessment of combustion emissions from biomass derived aviation fuels.		0.000	0.000	0.883	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602203F Aerospace Propulsion	PROJECT NUMBER 625330

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601102F/ Defense Research Sciences.	0.000	0.000							Continuing	Continuing
PE 0602805F/ Dual Use Science and Technology.	0.000	0.000							Continuing	Continuing
PE 0603216F/ Aerospace Propulsion and Power Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	118.740	128.447	121.768						Continuing	Continuing
622002: Electronic Component Technology	24.370	32.189	31.041						Continuing	Continuing
622003: EO Sensors & Countermeasures Tech	26.054	19.279	17.082						Continuing	Continuing
6244SP: Space Sensors	9.951	8.886	0.000						Continuing	Continuing
624916: Electromagnetic Tech	13.926	18.271	19.137						Continuing	Continuing
626095: Sensor Fusion Technology	19.383	25.470	18.433						Continuing	Continuing
627622: RF Sensors & Countermeasures Tech	25.056	24.352	36.075						Continuing	Continuing

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) radio frequency 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 radio frequency sensors and electronic combat 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 sensor, electronics, and electronic combat technologies.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	121.242	109.048	104.557	
Current BES/President's Budget	118.740	128.447	121.768	
Total Adjustments	-2.502	19.399	0.000	
Congressional Program Reductions	0.000	-0.053		
Congressional Rescissions	0.000	-0.348		
Total Congressional Increases	0.000	21.400		
Total Reprogrammings	-1.412	-1.600		
SBIR/STTR Transfer	-1.090	0.000		

Change Summary Explanation

Note: In FY 2009, Congress added $1.6M for Information Quality Tools For Persistent Surveillance Data Sets; $0.8M for Net-Centric Sensor Grids; $2.8M for the Optically Pumped Atomic Laser; $2.4M for Sensor Fusion; $0.8M for Watchkeeper; $1.6M for Weather Sensors for Cursor on Target; $0.8M for Advanced Data Exploitation and Visualization; $3.0M for Low Voltage, Wideband Electro-Optic Polymer Modulators; $1.6M for Persistent Sensing Data Processing, Storage, and Retrieval; $1.6M for Space Qualification of the Common Data Link; $2.0M for the Super-Resolution Sensor System; and $2.4M for the Wideband Digital Airborne Electronic Sensing Array.

C. Performance Metrics
Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors					PROJECT NUMBER 622002	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
622002: Electronic Component Technology	24.370	32.189	31.041						Continuing	Continuing

Note

Note: In FY 2010, funds from Project 44SP are being moved to Project 2002 to better align efforts.

A. Mission Description and Budget Item Justification

This project focuses on generating, controlling, receiving, and processing electronic signals for radio-frequency sensor aerospace applications. The enabling technologies developed under this project will be used for intelligence, surveillance, reconnaissance, electronic warfare, 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, electronic warfare, navigation, and smart weapons.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop compact, affordable, multi-function components for communications, Global Positioning System, imaging, electronic warfare, intelligence, surveillance, and reconnaissance sensors. Develop advanced electronic and optoelectronic aperture subsystems that support affordable and scalable sensors. Develop sources and detectors for electronic and optoelectronic sensors. Develop metamaterials for conformal arrays. Note: In FY 2009, this increase in funding is due to greater emphasis on metamaterials. Decrease in FY 2010 reflects the transfer of all efforts except metamaterials to other Major Thrusts. In FY 2008: Developed integrated wideband multi-channel phased array subarray with digital receiver and exciter architecture for future multi-intelligence electronic warfare and radar applications. Finished demonstration of distributed receiver/exciter architecture for advanced multi-function systems used in radar and electronic warfare sensors.	4.704	10.707	6.395	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 622002	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Demonstrate integrated wideband subarray for future multi-intelligence electronic warfare and radar applications. Design and develop digital receiver components to enable full digital receiver and exciter capabilities per transmit/receive site to enable future software-controlled phased arrays. Develop new hardware to exploit emerging metamaterials for compact radiating sensor applications including conformal array antennas and electronics based upon complex media. Evaluate the potential for highly-integrated electronics and apertures using low electromagnetic interference integrated devices and circuits through the use of metamaterials as three-dimensional electronic building blocks including laboratory prototyping of electrically small, compact radiating elements. In FY 2010: Demonstrate prototype wideband digital channel. Continue to develop and exploit metamaterials for electronic and optoelectronic applications. Demonstrate sensing subsystem using most promising metamaterials technology.					
MAJOR THRUST: Develop new microelectronic component technologies for radar, electronic warfare, and communications to support intelligence, surveillance, reconnaissance, precision strike, and battlespace access capabilities using advances in material research and microelectronic fabrication techniques. In FY 2008: Fabricated and performed lab testing to investigate physical and chemical properties of microcircuits under operating conditions to understand operating lifetime-limiting changes in structure. Continued development of electronics modeling and assessment techniques. Developed flexible and visually-transparent radio-frequency electronics. 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 visually-transparent radio-frequency electronics.		6.223	5.419	4.273	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 622002	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Demonstrate closed-loop modeling and prediction capability for emerging electronic device performance versus lifetime in militarily relevant environments. Investigate and test innovative electronic device concepts for wideband, reconfigurable and tunable applications.					
MAJOR THRUST: Develop optoelectronics for next generation imaging and electronic warfare sensors. Develop electro-optical devices for next-generation warfighter applications. In FY 2008: Demonstrated photonic radio-frequency modulation components for radio-frequency links and arbitrary electro-optical waveform generation. Continued development of vertical external cavity surface emitting lasers as compact, efficient, high-brightness sources. Continued development of fiber-optics and optical components for high-power mid-infrared applications. In FY 2009: Continue development of vertical external cavity surface emitting lasers as compact, efficient, high-brightness sources. Complete development of fiber-optics and optical components for high-power mid-infrared applications. Develop ultra-stable, tunable, mode-locked lasers to enable highly integrated optical waveform generation. In FY 2010: Demonstrate compact, efficient, high-brightness sources, optically- and/or electrically-pumped. Start the development for compact, tunable detector technology for advanced multi-spectral applications. Continue development of optical waveform generation subsystems. Initiate effort for combined spectral and polarimetric filtering at detector pixel level; extending to next-generation spectro-polarimetric focal plane array development.		3.183	4.301	3.833	
MAJOR THRUST: Develop, fabricate, and test electronic and optoelectronic components and techniques to reduce both power loss and power consumption for future imaging, electronic warfare, and intelligence, surveillance, and reconnaissance sensors. Develop and integrate adaptable circuit technologies that utilize dynamic elements and low-loss signal control for multi-function imaging and electronic warfare sensors used		3.738	2.256	8.726	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 622002	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
for intelligence, surveillance, reconnaissance, and battlespace access capabilities. Increase in FY 2010 reflects the realignment of efforts within the Project. In FY 2008: Developed and demonstrated adaptable microcircuits for multi-function sensors. Emphasized emerging electronic approaches for energy-starved circuit applications. In FY 2009: Develop tunable and reconfigurable wideband amplifiers for use in multi-function radar and electronic warfare sensors. Emphasize emerging electronics approaches for energy-starved circuit applications. In FY 2010: Demonstrate tunable and reconfigurable electronic and optoelectronic components for combined imaging and electronic warfare applications. Continue development of solutions for energy starved applications.					
MAJOR THRUST: Exploit promising emerging electronics concepts for imaging and electronic warfare from devices to subsystems for intelligence, surveillance, reconnaissance, and battlespace access capabilities. Develop and demonstrate innovative radio-frequency component technology that lowers system cost through reduction of design costs, part count, chip size, production costs, and integration costs. In FY 2008: Investigated microcircuit integration modeling and simulation tools to enable two-dimensional and three-dimensional electronics. In FY 2009: Develop and demonstrate highly integrated phase control components for use in wideband multi-function sensors. In FY 2010: Design and develop highly reconfigurable fully programmable microwave array and flexible optoelectronic integrated circuits using highly integrated techniques for lighter weight radio-frequency and optical apertures.		3.261	1.861	1.017	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 622002	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop and validate the integrated design, modeling and simulation tools, and integration techniques for complex mixed-signal (digital, radio-frequency, microwave, etc.) component development in both advanced and emerging electronic component technologies. Increase in FY 2010 reflects the realignment of efforts within the Project. In FY 2008: Continued design and refinement of models for next-generation high-power components that operate under extreme conditions and enable multi-function sensors. In FY 2009: Demonstrate closed loop characterization of performance driven component and device design, fabrication, and characterization with first pass success. In FY 2010: Extend design and characterization capability to tunable, reconfigurable and multi-function electronic and optoelectronic devices and components.		3.261	1.861	5.149	
MAJOR THRUST: Develop advanced component technology for space-base sensors that focuses on improving performance and reducing size, mass, and prime power. Utilize advanced materials to demonstrate low-mass, low cost, reliable, and scalable apertures. Develop advanced active phased array antenna subsystems to meet the unique requirements of affordable space-based sensing including the restrictions on mass, size, and power. Supports intelligence, surveillance, and reconnaissance capabilities. Note: Prior to FY 2010, this effort was performed in Project 44SP. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop reconfigurable/tunable high performance electronics/circuits. Investigate pre-space qualification issues associated with newer component technologies to ensure more rapid and accurate transitions. Develop scalable/reconfigurable plug-and-play payload building blocks.		0.000	0.000	1.648	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors	PROJECT NUMBER 622002

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: Optically Pumped Atomic Laser (OPAL). Note: In FY 2008, this effort was conducted as part of Project 2003. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for the OPAL. In FY 2010: Not Applicable.	0.000	2.792	0.000	
CONGRESSIONAL ADD: Low Voltage, Wideband Electro-Optic Polymer Modulator. Note: In FY 2008, this effort was conducted as part of Project 2003. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Low Voltage, Wideband Electro-Optic Polymer Modulator. In FY 2010: Not Applicable.	0.000	2.992	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors	PROJECT NUMBER 622002

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Technology.	0.000	0.000							Continuing	Continuing
PE 0603203F/ Advanced Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603270F/ Electronic Combat Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors					PROJECT NUMBER 622003	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
622003: EO Sensors & Countermeasures Tech	26.054	19.279	17.082						Continuing	Continuing

Note

Note: In FY 2010, funds from Project 44SP move to Project 2003 within this Program Element to better align efforts.

A. Mission Description and Budget Item Justification

This project determines the technical feasibility of advanced electro-optical aerospace sensor technologies for a variety of offensive and defensive uses. The sensor technologies under development range from the ultraviolet through the infrared 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 electro-optical 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 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 electro-optical threat warning and countermeasures.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop technology for non-cooperative detection and identification of airborne, space, and ground-based targets. In FY 2008: Performed phenomenology experiments for multi-discriminant active/passive sensing and performed sensor concept modeling. Collected signature data for target discrimination and shape extraction using passive multispectral and polarimetric sensing techniques. Characterized the performance of a long-wave hyperspectral sensor for performing identification of gaseous targets. Demonstrated hybrid focal planes and read-out electronics for simultaneous multi-discriminant active and passive sensing, and developed image processing techniques for sensor data enhancement. Continued development of vibration signature catalogs, performance and signature models, and processing including initial automatic target recognition (ATR). In FY 2009: Perform sensor concept demonstrations for multi-discriminant active and passive sensing and quantify expected system performance. Characterize target discrimination and shape extraction performance using passive multispectral and polarimetric sensing techniques. Continue demonstration of hybrid focal	2.335	2.864	2.344	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 622003	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
planes and read-out electronics for simultaneous multi-discriminant active and 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. In FY 2010: Perform sensor concept demonstrations for long range target identification using passive and active techniques, including multispectral/polarimetric imaging, vibrometry, sparse aperture and synthetic aperture laser radar. Develop fused active and passive, multi-discriminant image products based on individual and combined measurement performance. Continue characterization of hybrid focal planes and demonstrate in short range ladar systems. Begin design of multi-discriminant system utilizing common components to minimize size and optimize utility. Continue optical sensor enhancements for improved space situation awareness experiments.					
MAJOR THRUST: Develop optical transmitter technology capable of sensing multiple target characteristics for robust non-cooperative target identification. Funding decreases in FY 2010 due to the completion of the sparse aperature testbed in FY 2009. In FY 2008: Extended development and testing of optical transmitter technologies for non-cooperative target identification to increased standoff ranges. Explored optical discriminants for long range identification including shape, polarization, and vibration using real-beam and synthetic aperture sensing techniques. Developed a sparse aperture testbed supporting spatial synthesis imaging. Developed advanced models to support phenomenology-driven sensor trade studies with both active and passive sensors. Performed tower and flight collections to validate system modeling results. Explored enabling sensor components to support extended range operation. 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. Complete development of sparse aperture testbed supporting spatial synthesis imaging. Develop optimal		6.548	5.275	0.514	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 622003	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2010: Complete testing of optical transmitter technologies for non-cooperative target identification at long standoff ranges. Continue to refine optimal system concepts using advanced active and passive sensor models with emphasis on imaging through scattering media such as clouds and foliage. Develop enabling sensor components for a demonstration system.					
MAJOR THRUST: Develop innovative techniques and components to target difficult objects in battlefield environments. In FY 2008: Extended development of techniques for targeting difficult objects in dynamic urban environments. Developed passive infrared components and techniques for continuous surveillance of broad areas with detection and tracking of dynamic targets and events. Continued development of non-mechanical beam steering for both passive and active sensors. Explored passive and active laser detection and range-sensing phenomenology techniques for capturing robust spectral, spatial, polarimetric, and radiometric signatures for moving target identification and track association in dense target areas. In FY 2009: Continue development of techniques for targeting difficult objects in dynamic urban environments. Perform concept demonstrations of continuous passive infrared surveillance of broad areas with detection and tracking of dynamic targets and events. Develop sensor concept designs for optimizing revisit rate and perform design trade-off experiments. Develop concepts for close-in sensing from UAV or small UAVs in difficult environments. Investigate small unmanned aerial vehicles (SUAV) applications of non-mechanical beam steering for pointing and stabilization. Perform spectral, spatial, polarimetric, and radiometric signature collection experiments using laboratory passive and active laser detection and ranging sensors for moving target identification and track association in dense target areas. In FY 2010: Continue development of techniques for targeting difficult objects in dynamic urban environments. Explore compact active and passive sensor components with advanced signal processing for distributed		3.596	4.738	6.093	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 622003	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
operation from small platforms to provide close-in sensing of difficult targets in obscured and urban areas. Demonstrate individual sensor components for close in sensing from SUAVs in difficult environments. Conduct flight phenomenology experiments supporting ladar applications on SUAVs.					
MAJOR THRUST: Develop countermeasure technologies for use against infrared- and electro-optical guided missiles threats. Increased funding in FY 2010 reflects increased emphasis in countering advanced threats. In FY 2008: Continued development of second-generation infrared-imaging missile seeker models and simulations for countermeasure technique development. Continued exploitation of advanced infrared missiles and infrared acquisition sensors for countermeasure technique updates and refinement. Initiated identification of discriminants for specific identification of new electro-optical sensors and missile threats. In FY 2009: Evaluate countermeasure techniques to defeat second-generation infrared-imaging missile seekers. Develop new countermeasure technique updates and refinements applicable to legacy systems. Continue identification of discriminants for specific identification of new electro-optical sensors and missile threats. In FY 2010: Assess technologies to defeat advanced infrared missiles and infrared acquisition sensors. Support demonstration of proactive detection, discrimination, and defeat of second-generation infrared-imaging missile seekers and sensors systems. Refine techniques and discrimination processes test data. Develop and refine simulation capability to evaluate effectiveness across mission concepts of employment.		2.591	2.877	7.672	
MAJOR THRUST: Develop aerospace missile and laser warning technologies to accurately cue countermeasures. In FY 2008: Continued developing new laser warning sensor technologies to address ultra-short and tunable laser threats. Identified methods to increase focal plane array dynamic range for precise characterization of low- and high-power laser threats.		0.546	0.732	0.459	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 622003	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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 and declaration ranges. In FY 2010: Support integration of new laser warning sensors with countermeasures system prototypes to provide robust capability to detect threats and cue defeat techniques. Refine sensor hardware and software design based on test data. Conduct demonstration testing of integrated capabilities. Develop new laser warning concepts to address emerging directed energy threats.					
CONGRESSIONAL ADD: Super-resolution Sensor System (S3). In FY 2008: Conducted Congressionally-directed effort for the Super-resolution Sensor System. In FY 2009: Continue to conduct Congressionally-directed effort for the Super-resolution Sensor System. In FY 2010: Not Applicable.		4.923	1.995	0.000	
CONGRESSIONAL ADD: Optically Pumped Atomic Laser (OPAL). Note: In FY 09, this effort continues under Project 2002. In FY 2008: Conducted Congressionally-directed effort for the OPAL. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		3.151	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors	PROJECT NUMBER 622003

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: Low Voltage, Wideband Electro-Optic Polymer Modulator. Note: In FY 09, this effort continues under Project 2002. In FY 2008: Conducted Congressionally-directed effort for Low Voltage, Wideband Electro-Optic Polymer Modulator. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	2.364	0.000	0.000	
CONGRESSIONAL ADD: Watchkeeper. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for the Watchkeeper. In FY 2010: Not Applicable.	0.000	0.798	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors	PROJECT NUMBER 622003

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Technology.	0.000	0.000							Continuing	Continuing
PE 0603253F/ Advanced Sensor Integration.	0.000	0.000							Continuing	Continuing
PE 0602301E/ Intelligence System Program.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors					PROJECT NUMBER 6244SP	
COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
6244SP: Space Sensors	9.951	8.886	0.000						Continuing	Continuing

Note

Note: In FY 2010, funds from Project 44SP are being moved to Projects 2002, 2003, and 7622 to better align efforts.

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 space sensor applications. The enabling technologies will be used for intelligence, surveillance, reconnaissance, 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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 needs 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. In FY 2008: Defined specific responsive space sensor functional capabilities and implementation assessments. Modeled size-, weight-, and power-restricted 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. In FY 2009: Experimentally assess responsive "plug-and-play" satellite implementation concept. Design size-, weight-, and power-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.	3.031	2.738	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 6244SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
MAJOR THRUST: Develop advanced active phased array antenna subsystems to meet the unique requirements of affordable space-based sensing including restrictions on mass, size, and power. Utilize advanced materials to demonstrate low-mass, low cost, reliable, and scalable apertures. Develop multi-band and multi-beam forming technologies. Address technologies for antenna array operations in dynamic sensor networks. Supports intelligence, surveillance, and reconnaissance capabilities. In FY 2008: Developed sub-array level digital beam-forming and low-cost L-band antenna panels. In FY 2009: Experimentally assess enhanced antenna signal interference compatibility capability. In FY 2010: Not Applicable.		3.311	2.230	0.000	
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. In FY 2008: Evaluated adaptive transmit and receive techniques for surface moving target indication from space under a variety of tactical scenarios and interference environments. In FY 2009: Integrate the developed algorithms, waveforms, and space platform scenarios into a surveillance network of sensors. In FY 2010: Not Applicable.		1.489	1.030	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 6244SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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 intelligence, surveillance, and reconnaissance capabilities. In FY 2008: Validated new low-cost radio-frequency sub-assembly technology compatibility for space qualification. Evaluated plastic packaging, liquid crystal polymer packages, and flexible radio-frequency boards. In FY 2009: Develop compact tunable filters for interference signal rejection in dense signal environments. In FY 2010: Not Applicable.		0.882	1.501	0.000	
MAJOR THRUST: Develop sensor techniques 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. In FY 2008: Modeled hypersonic air vehicle plasma characteristics, platform trajectories, and highly accurate and robust navigation techniques for space-based applications. Developed a constructive systems engineering model to assess hypersonic navigation techniques in terms of measures of performance and warfighter utility. In FY 2009: Design a radio-frequency 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. Continue developing a constructive systems engineering model to assess hypersonic navigation techniques in terms of measures of performance and warfighter utility. In FY 2010: Not Applicable.		1.238	1.387	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors	PROJECT NUMBER 6244SP

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Tech.	0.000	0.000							Continuing	Continuing
PE 0603203F/ Advanced Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603500F/ Multi-Disciplinary Adv Dev Space Tech.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors					PROJECT NUMBER 624916	
COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
624916: Electromagnetic Tech	13.926	18.271	19.137						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops technologies for sensor systems that cover the electromagnetic spectrum from radio-frequency to electro-optical. It develops radio-frequency antennas and associated electronics for airborne and space-based surveillance. It also investigates radio-frequency scattering phenomenology for applications in ground and air moving target indicators in extremely cluttered environments. The project develops active and passive electro-optical sensors for use in concert with radio-frequency 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Investigate detection of difficult airborne and ground-based targets in clutter from airborne or space-based surveillance platforms. In FY 2008: Developed techniques for fully-adaptive sensing and processing combining electromagnetic phenomenology, cognitive algorithms, and signal processing pertaining to waveform diverse sensing and distributed sensing. 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 electromagnetic models of targets and clutter. In FY 2010: Continue to 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 electromagnetic models of targets and clutter.	3.037	2.593	3.144	
	3.237	6.502	6.807	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 624916	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Design and develop antennas for airborne and space-based surveillance. Develop metamaterials for conformal arrays. Note: In FY 2009, this increase in funding is due to greater emphasis on metamaterials. In FY 2008: Integrated optimal algorithms with mixed circuit radio-frequency wide-band beam-forming hardware to demonstrate lower cost lightweight sensor platforms. Demonstrated low-cost miniature seeker hardware. Transitioned newly developed digital beamforming architectures to new airborne radar platforms. In FY 2009: Develop new low-cost digital beamforming techniques for miniature unmanned aerial vehicles. Integrate new detection algorithm with low cost seeker hardware. Integrate and test new conformal digital beamforming phased array antennas on airborne radar platforms. Develop new hardware to exploit emerging metamaterials for compact radiating sensor applications including conformal array antennas and electronics based upon complex media. Assess the viability of obtaining metamaterial properties consistent with the demonstration of highly integrated subsystems based upon radio frequency integrated circuit applications to enable small, highly directional antenna element device drivers. In FY 2010: Continue to develop new low-cost digital beamforming techniques for miniature unmanned aerial vehicles. Integrate new detection algorithm with low cost seeker hardware. Continue integration and test of new conformal digital beamforming phased array antennas on airborne radar platforms. Continue to develop new hardware to exploit emerging metamaterials for compact radiating sensor applications including conformal array antennas and electronics based upon complex media. Continue to assess the viability of obtaining metamaterial properties consistent with the demonstration of highly integrated subsystems based upon radio frequency integrated circuit applications to enable small, highly directional antenna element device drivers.					
MAJOR THRUST: Design and develop new electro-optical techniques and components for detecting and identifying concealed targets. In FY 2008: Developed new focal plane array materials and avalanche photo-detector device technologies to enhance autonomous munitions, staring focal plane arrays, and target identification and tracking applications.		2.645	3.848	5.523	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 624916	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Developed two-dimensional pixel-based electronic control circuits for enhanced imaging. Integrated these focal plane arrays with the electronic control circuits for a compact three-dimensional focal plane array capability. In FY 2009: Develop new quasi-phase matched materials such as Gallium Phosphate and techniques for efficient optical sources in the mid- and long-wave infrared applications. New materials systems will be developed to enable conversion from pump wavelengths between 1 and 2 microns. Continue testing of integrated focal plane arrays. In FY 2010: Continue to develop new quasi-phase matched materials such as Gallium Phosphate and techniques for efficient optical sources in the mid- and long-wave infrared applications. Continue developing new materials systems to enable conversion from pump wavelengths between 1 and 2 microns. Continue testing of integrated focal plane arrays.					
MAJOR THRUST: Develop hardware and software for passive multi-dimensional sensing in the thermal infrared spectral wavelength range at high frame rates. In FY 2008: Performed critical technical assessments via field testing on hyperspectral electro-optical sensors developed in prior years. Evaluated the potential of sensing rapidly changing electro-optical spectra from hot battlefield events (for example, rocket propelled grenades, mortars, man-portable air defense systems, and muzzle flash). Used 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. Performed initial testing on a new hyperspectral approach to finding and identifying toxic gas clouds. In FY 2009: Develop new electro-optical sensor hardware for detecting chemical, biological, radioactive, nuclear, or high explosive 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.		3.235	2.935	3.663	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Continue to develop new electro-optical sensor hardware for detecting chemical, biological, radioactive, nuclear, or high explosive weapons using spectral/hyperspectral intelligence. Continue 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. Continue utility assessment of hyperspectral sensors for collecting data at millisecond sample rates for space-based applications. Apply spectral temporal sensor technology for cueing electro-optical and infrared persistent surveillance sensors.					
CONGRESSIONAL ADD: Center for Advanced Sensor and Communication Antennas. In FY 2008: Conducted Congressionally-directed effort for the Center for Advanced Sensor and Communication Antennas. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.984	0.000	0.000	
CONGRESSIONAL ADD: Optimal Maximum Entropy Verification (OMEV). In FY 2008: Conducted Congressionally-directed effort for Optimal Maximum Entropy Verification (OMEV). In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.788	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors	PROJECT NUMBER 624916

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: Wideband Digital Airborne Electronic Sensing Array (WDAESA). In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for WDAESA. In FY 2010: Not Applicable.	0.000	2.393	0.000	

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Technology.	0.000	0.000							Continuing	Continuing
PE 0602702F/ Command Control and Communications.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors					PROJECT NUMBER 626095	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
626095: Sensor Fusion Technology	19.383	25.470	18.433						Continuing	Continuing

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, automatic target recognition, 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. This project also develops the technologies required to create trusted autonomic, distributed, collaborative, and self-organizing sensor systems that provide anticipatory and persistent intelligence, surveillance, and reconnaissance (ISR) situational awareness and decision support for multi-layered sensing. This program provides the technologies for: 1) trusted sensors and trusted sensor systems that will deter reverse engineering and exploitation of our critical hardware and software technology and impede unwanted technology transfer, alteration of system capability, and prevent the development of countermeasures to U.S. systems; 2) collaborative tasking of our own distributed heterogeneous sensor networks across a region and co-opted tasking of both traditional and non-traditional adversary sensors; 3) secure sensor web backbone technologies, sensor web physical topologies, and related protocols to assure reliable trusted sensor interactions; and 4) defining architectures for distributed trusted collaborative heterogeneous sensor systems and semantic sensor networks, developing new methodologies for system of systems sensor engineering and analysis, and new techniques for sensor network situation awareness and predictive analytics.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop and assess single and multi-sensor automatic target recognition and sensor fusion algorithms for rapidly finding, tracking, and targeting mobile targets. In FY 2008: Developed improved image formation and processing of synthetic aperture radar data from research and development data collections. Continued to develop image and data formation and processing of electro-optical, infrared, hyper-spectral imagery data from research and development data collections. Continued development of multi-sensor and multi-frequency synthetic data generation tools to augment and enhance collected research, development, and operational data sets. Continued laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Enhanced automatic target recognition performance evaluation theory for radar automatic target recognition technology and continued for electro-optical and multiple-sensor automatic target recognition	1.240	1.414	2.019	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
technologies. Continued assessment methods and measures for moving target tracking and identification approaches using multiple sensor types. Continued development of analysis methods and measures for assessing automated exploitation and rapid response systems proposed for post-conflict force protection, stability, and security operations. In FY 2009: Assess the image formation and processing of synthetic aperture radar, electro-optical/infrared/ hyper-spectral imagery data from research and development data collections taking advantage of disparate phenomenology to improve automatic target recognition detection, classification and identification performance. Develop and validate multi-sensor/multi-frequency synthetic data generation tools required to augment and enhance collected research, development, 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 automatic target recognition performance evaluation theory for radar automatic target recognition technology and continue for electro-optical and multiple-sensor automatic target recognition technologies. Continue assessment methods and measures for moving target tracking and identification 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. In FY 2010: Continue to assess the image formation and processing of synthetic aperture radar, electro-optical/infrared/hyper-spectral imagery data from research and development data collections taking advantage of disparate phenomenology to improve automatic target recognition detection, classification and identification performance. Continue to develop and validate multi-sensor/multi-frequency synthetic data generation tools required to augment and enhance collected research, development, and operational data sets. Search out unexploited phenomenological features and initiate development of tools and technology required to exploit said features. Continue laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Continue enhancements to databases, tools and laboratory environments as required to support assessment and validation of models and exploitation technologies. Continue to improve automatic target recognition performance evaluation theory for automatic target recognition technologies. Continue to develop assessment methods and measures for moving target tracking and identification approaches using multiple sensor types. Continue development of analysis methods				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
and measures for assessing automated exploitation and rapid response systems proposed for post-conflict force protection, stability, and security operations.					
MAJOR THRUST: Develop, evaluate, and demonstrate target signature models to support automatic target recognition and sensor fusion algorithm development and testing for reconnaissance and strike mission applications. In FY 2008: Developed and validated target signature models for signature exploitation of radio-frequency sensors, electro-optical multi-spectral systems, and signals intelligence sensors. Developed signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology automatic target recognition of tactical ground targets; introduce civilian vehicles. Continued to generate synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Continued demonstration of a synthetic scene data generation capability for radio-frequency scenes and continued development of an electro-optical scene capability applicable to large area reconnaissance coverage. Continued investigation of model-driven spectral signal processing and exploitation techniques. Measured performance of initial automatic target recognition algorithm-driven radio-frequency sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high-diversity data. In FY 2009: Continue to mature target signature models for signature exploitation of radio-frequency sensors, electro-optical multi-spectral systems, and signals intelligence sensors. Continue to develop signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology automatic target recognition of tactical ground targets. 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 demonstration of a synthetic scene data generation capability for radio-frequency scenes and continue development of an electro-optical scene capability applicable to large area reconnaissance coverage. Continue investigation of model-driven spectral signal processing and exploitation techniques. Continue development of automatic target		3.137	3.480	4.838	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
recognition algorithm-driven radio-frequency sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high-diversity data. In FY 2010: Continue to mature target signature models for signature exploitation of radio-frequency sensors, electro-optical multi-spectral systems, and signals intelligence sensors emphasizing one target model for application to all parts of the spectrum. Continue to develop signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology automatic target recognition of ground targets. Continue search for and 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 development and assessment of automatic recognition of targets in operationally realistic mission environments. Continue demonstration of large area, reconnaissance coverage, synthetic scene data generation capability for radio-frequency and electro-optical sensors. Continue investigation of model-driven spectral signal processing and exploitation techniques. Continue development of automatic target recognition algorithm-driven radio-frequency sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high-diversity data.				
MAJOR THRUST: Develop and demonstrate enabling automatic target recognition, sensor management, and sensor fusion technologies for target detection, tracking, and identification in intelligence, surveillance, reconnaissance, and combat identification applications. Note: In FY 2010, efforts were reduced in this Project due to higher AF priorities. In FY 2008: Developed and validated a fusion capability of exploitable radar, electro-optical, infrared, laser detection and ranging, and hyperspectral features for target detection, tracking, and identification with sensor management techniques. Evaluated physics-based techniques for target detection and identification for intelligence, surveillance, and reconnaissance and combat identification applications. Initiated development of automated battle space behavior analysis. Continued development and initiated assessment 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. Continued development of multi-sensor pixel level registration techniques. Continued development of capabilities to represent and utilize sensor	8.377	5.136	1.940	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Continued research of bio-inspired automatic target recognition for robustness. Extended automatic target recognition, sensor management, and sensor fusion research for urban intelligence, surveillance, and reconnaissance from small unmanned aerial vehicles to include civilian objects of interest. In FY 2009: Complete initial fusion capability for radar, electro-optical/infrared, laser detection and ranging, and hyperspectral features for target detection, tracking, and identification with sensor management techniques. Evaluate and improve of physics-based techniques for target detection and identification for intelligence, surveillance, and reconnaissance and combat identification 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 inclusion into fusion functions. Complete and evaluate 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 automatic target recognition for robustness and initiate evaluation of these techniques for urban applications. Evaluate automatic target recognition, sensor management, and sensor fusion research for urban intelligence, surveillance, and reconnaissance from small unmanned aerial vehicles. In FY 2010: Demonstrate and assess fusion capability for radar, electro-optical/infrared, laser detection and ranging, and hyperspectral features for target detection, tracking, and identification with sensor management techniques. Enhance physics-based techniques to meet the target detection and identification requirements for intelligence, surveillance, and reconnaissance and combat identification applications. Continue development and evaluation of automated battle space behavior analysis. Continue development and assessment of technology that will fuse precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Enhance multi-sensor, pixel level registration techniques as necessary to support requirements. Continue to assess and develop 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 automatic target recognition technologies and continue to assess and evaluate these techniques for all missions with emphasis				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 626095	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
on urban applications. Evaluate automatic target recognition, sensor management, and sensor fusion research for urban intelligence, surveillance, and reconnaissance from small unmanned aerial vehicles.					
MAJOR THRUST: Develop fundamental technical methods required for algorithm performance models, automatic target recognition driven sensing, layered sensing and other sensing and exploitation technologies impacted by automatic target recognition capabilities. Note: This work is an outgrowth of other work within this project. In FY 2008: Assessed the state of the art in automatic target recognition predictive methods. Determined exploitation and sensing technologies that require the integration of automatic target recognition techniques. Developed fundamental automatic target recognition approaches for various subcomponents. In FY 2009: Evaluate new innovations in automatic target recognition-related technologies. Continue development of fundamental automatic target recognition approaches for subcomponents. Begin development of an integrated, unified automatic target recognition methodology, building upon the various automatic target recognition subcomponent efforts. In FY 2010: Continue evaluation of new innovations in automatic target recognition-related technologies. Continue development of fundamental automatic target recognition approaches for subcomponents. Begin development of a capability to model the performance of these technologies. Determine methods of performance modeling validation. Develop databases and tools required to support performance modeling and assessment. Continue development of an integrated, unified automatic target recognition methodology building upon the modeling and assessment tools developed.		1.466	1.500	1.477	
MAJOR THRUST: Develop, evaluate, and demonstrate methodologies, techniques, and strategies to instill trust in distributed, heterogeneous sensing systems within air, space, and cyber application domains.		3.588	4.488	4.805	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Developed new technologies and methodologies for defining adaptive architectures for distributed trusted collaborative heterogeneous sensor systems and semantic sensor networks. Developed new techniques for system of systems sensor engineering and analysis. Initiated development of new techniques for sensor network situational awareness and predictive analytics to optimize object driven, self-organizing collaborative sensor systems for multi-layered sensing. In FY 2009: Continue development of new technologies and methodologies for defining adaptive architectures for distributed trusted collaborative heterogeneous sensor systems and semantic sensor networks. Continue to develop new techniques for system of systems sensor engineering and analysis. Continue to develop new techniques for sensor network situational awareness and predictive analytics to optimize object driven, self-organizing collaborative sensor systems for multi-layered sensing. Initiate research into sensor network science to identify critical areas and technologies needed for next generation semantic sensor networks. In FY 2010: Complete development of new techniques for systems sensor engineering and analysis. Complete development of new techniques for sensor network situational awareness and global measures of trust for multi-layered sensing. Complete development of representative measures of system trustworthiness for collaborative and distributed heterogeneous sensing system architectures and semantic sensor networks. Continue development of new technologies and methodologies for producing adaptive, trusted architectures for multi-layered sensing.					
MAJOR THRUST: Develop, assess, evaluate, and demonstrate technologies that enable autonomic trusted features in sensor systems to deter reverse engineering and exploitation of critical military hardware and software systems. This effort is brokenout separately in FY 2010 due to increased emphasis on developing trusted system technology. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		0.000	0.000	1.102	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Develop and demonstrate critical technologies for trusted sensors for multi-layered ISR sensing systems to assure anti-tamper and software protection of key military capabilities. Assess and evaluate commercial technologies for application to military trusted systems. Develop and demonstrate secure cyber sensing station for ISR and cyberspace applications. Initiate development of autonomic trusted sensor technologies to address self-ware, self-healing, and self-organizing sensor systems.				
MAJOR THRUST: Develop, evaluate, and demonstrate secure backplane, integration technology, physical topologies, and related protocols to support multi-layered sensing and trusted sensor networks for air, space, and cyber domains. This effort is broken out separately in FY 2009 due to increased emphasis in development of integrated multi-layer sensor technology. In FY 2008: Not Applicable. In FY 2009: Initiate development of conceptual design of sensor web backbone technology to assure trusted sensor interactions for multi-layered persistent ISR sensing leveraging commercial infrastructure and components. Initiate development of sensor web backbone integration laboratory to assess and evaluate critical sensor data link technologies and physical topologies for secure sensor networks. In FY 2010: Complete conceptual design conceptual design of sensor web backbone technology to assure trusted sensor interactions for multi-layered persistent ISR sensing. Continue development of sensor web backbone integration laboratory. Complete initial assessment of available sensor technologies for trusted sensing. Initiate development of advanced sensor bus technologies for trusted sensing. Initiate analysis to exploit wired and wireless sensor web systems.	0.000	2.270	2.252	
CONGRESSIONAL ADD: Sensor Fusion. In FY 2008: Conducted Congressionally-directed effort for Sensor Fusion.	1.575	2.394	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 626095	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Conduct Congressionally-directed effort for Sensor Fusion. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Advanced Data Exploitation and Visualization. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Advanced Data Exploitation and Visualization. In FY 2010: Not Applicable.		0.000	0.798	0.000	
CONGRESSIONAL ADD: Information Quality Tools for Persistent Surveillance Data Sets. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Information Quality Tools for Persistent Surveillance Data Sets. In FY 2010: Not Applicable.		0.000	1.596	0.000	
CONGRESSIONAL ADD: Net-Centric Sensor Grids. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Net-Centric Sensor Grids.		0.000	0.798	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: Persistent Sensing Data Processing, Storage and Retrieval. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Persistent Sensing Data Processing, Storage and Retrieval. In FY 2010: Not Applicable.	0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Technology.	0.000	0.000							Continuing	Continuing
PE 0603203F/ Advanced Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0602602F/ Conventional Munitions.	0.000	0.000							Continuing	Continuing
PE 0603270F/ Electronic Combat Technology.	0.000	0.000							Continuing	Continuing
PE 0603226E/ Experimental Evaluation of Major Innovative Technologies.	0.000	0.000							Continuing	Continuing
PE 0603762E/ Sensor and Guidance Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
627622: RF Sensors & Countermeasures Tech	25.056	24.352	36.075						Continuing	Continuing

Note

Note: In FY 2010, funds from Project 44SP are being moved to Project 7622 to better align efforts.

A. Mission Description and Budget Item Justification

This project develops and assesses affordable, reliable all weather radio-frequency sensing and countermeasure concepts for aerospace applications covering the range of radio frequency sensors including communications, navigation, intelligence, surveillance, reconnaissance, and radar, both active and passive, across the air, land, sea, space and cyber domains. This project also develops and evaluates technology for intelligence, surveillance, and reconnaissance sensors, fire control radars, electronic warfare, integrated radar and electronic warfare systems, and offensive information operations systems. It emphasizes the detection and tracking of surface and airborne targets with radio-frequency 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 radio-frequency phenomenologies, multi dimensional adaptive processing, advanced waveforms and knowledge-aided processing techniques. This project also develops the radio-frequency warning and countermeasure technology for advanced electronic warfare and information operations applications. Specifically, it develops techniques and technologies to detect and counter the communications 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 radio-frequency sensors, including radar warning, radio-frequency electronic warfare, and electronic intelligence applications.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop technologies and techniques to provide significant size, weight, and power (SWaP) reductions in radio-frequency sensors compatible with severely constrained unmanned air platforms. Reduced SWaP enables sensor installations on small unmanned aerial systems which could not otherwise carry RF sensors, and improved sensor performance through additional capability on larger platforms. Develop technology for optimal control of active and passive RF and multi-intelligence sensor suites in response to changing mission goals and environments. Develop technology to enable affordable upgrades to radio-frequency signal receivers. In addition to SWaP reductions these improvements include increased bandwidth and sensitivity, and responsiveness to a greater range of waveforms.	16.197	7.519	5.403	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Completed initial demonstration of advanced mode control concepts to provide concurrent multi-function radio-frequency sensors and electronic warfare compatibility on a single platform. Developed integrated radio-frequency (sensors and electronic warfare) and electro-optical modeling, simulation, and analysis capabilities to address broader system-level multi-intelligence trades. Developed advanced digital receiver techniques for adaptive electronic support for passive multi-mode platform operations. Continued development and evaluation of advanced digital receiver/exciter technologies for electronic support, electronic protection, electronic attack, and radar applications that support multiple degrees-of-freedom adaptivity. Continued development and evaluation of advanced digital receiver signal processing concepts/techniques for adaptive operation in complex signal environments. Performed digital receiver/exciter simulation, modeling, and analysis for electronic warfare scenarios in modern signal environments. Refined reductions in size, weight, and power in radio-frequency sensors compatible with severely constrained unmanned air platforms. In FY 2009: Demonstrate integration of an electronic warfare and surveillance suite in a size, weight, and power constrained environment. Continue to develop and evaluate advanced mode control concepts to provide concurrent radio-frequency sensors and electronic warfare with electro-optical compatibility on a single platform. Define approaches allowing the simultaneous design and development of sensors and their back-end exploitation functions. Develop advanced electronic support 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 electronic support, electronic protection, electronic attack, and active and passive multi-mode sensor applications. Continue digital receiver simulation, modeling, and analysis for electronic warfare scenarios in modern signal environments. Continue to refine reductions in size, weight, and power in radio-frequency sensors compatible with severely constrained unmanned air platforms. In FY 2010: Continue demonstration of advanced RF receiver hardware and digital receiver/techniques generators technologies. Initiate new effort for the development of an adaptable (cognitive) ES and/or EA capability.				
	0.803	4.751	4.900	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 627622	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop robust, ultra-wide bandwidth antenna technology for use in operational and future aerospace platform electronic apertures. Develop innovative technologies and architectures for extremely wideband apertures to provide additional multi-level functionality for advanced manned and unmanned platforms. Assess next generation applied radio-frequency aperture technology. Effort completes in FY 2010. In FY 2008: Integrated compact digital receiver/exciter to thin-profile array. In FY 2009: Lab demonstration and testing of thin-profile array with integrated receiver and exciter. In FY 2010: Complete design and development of multi-function thin-profile array with integrated receiver and exciter.					
MAJOR THRUST: Develop multi-function radio-frequency sensing and electronic warfare/information operations concepts and radio-frequency transformational element level arrays for concurrent multi-mode operation. In FY 2008: Developed autonomous constellation of active and passive air, space, and ground sensor techniques for close-in sensing applications using distant sources of opportunity. Designed and developed panel technology for multi-mode array to demonstrate concurrent operation. In FY 2009: Conduct lab demonstration of autonomous constellations of active and passive air, space, and ground sensor techniques for close-in sensing and electronic warfare/information operations applications using distant sources of opportunity. Demonstrate and test multi-mode array with element-level digital beam forming. In FY 2010: Design and develop highly digital electronically scanned array with transmit and receive capabilities for multi-mode radio frequency sensing. Develop integrated receiver/exciter and digital beamforming concepts to support wideband multi-INT sensing systems including modeling and simulation capability, critical components, algorithms, and subsystem architectures.		1.217	2.919	2.796	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 627622	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop digital radio frequency receiver and exciter technology to support digital beam forming and electronic warfare/information operations applications. This thrust emphasizes advanced, adaptive digital receivers and exciters for cognitive electronic support and electronic attack applications. In FY 2008: Developed subsystem engineering, simulation, and characterization technologies for integrated wideband radio-frequency aperture, wideband receiver and exciter, and digital beam-forming signal processing. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		2.271	0.000	0.000	
MAJOR THRUST: Develop advanced waveforms for achieving transmit adaptivity and simultaneous multi-mode operation to improve interference rejection, electronic protection, and target identification by exploiting diversity in frequency, delay, polarization, and modulation and coding. Develop multi-platform, multi-mission sensor, and electronic warfare adaptive processing algorithms that improve detection, location, and electronic attack performance. In FY 2008: Evaluated distributed processing technology for next generation deep-reach target detection and tracking. Utilized high fidelity simulation tools. Planned for future experiments. In FY 2009: Initiate and conduct experiments to demonstrate the advantages and performance improvements of adaptive transmit waveforms, new distributed signal processing techniques, and distributed sensing and electronic warfare/information operations for multi-band, multi-platform, multi-mode, and shared aperture applications. In FY 2010: Investigate and evaluate waveform diversity techniques and multiple-input/multiple-output adaptive processing algorithms to improve electronic protection functions in conventional and advanced radio-frequency systems. Continue development of distributed signal processing techniques to obtain high spatial		4.568	7.567	14.698	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 627622	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
resolution with limited transmit bandwidth, and to detect challenging targets such as those with low radar cross-section.					
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 needs 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. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Investigate optimal means of tightly coupling networked sensing platforms with their reference systems by leveraging onboard sensors observations as feedback to robustly calibrate the distributed, multi-platform reference. Conduct ground-based demonstration of modular payload building blocks compatible with operationally responsive space rapid integration requirements.		0.000	0.000	5.265	
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. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Evaluate advanced surface moving target indication algorithms and computing architectures for high altitude, environmentally constrained radio frequency sensing system applications. Evaluate emissions mapping and bistatic radar techniques for providing space situational awareness.		0.000	0.000	1.732	
MAJOR THRUST: Develop multi-band and multi-beam forming technologies. Address technologies for antenna array operations in dynamic sensor networks. Supports intelligence, surveillance, and reconnaissance capabilities.		0.000	0.000	0.160	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors			PROJECT NUMBER 627622	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Demonstrate a responsive space payload.					
MAJOR THRUST: Develop sensor techniques to achieve highly accurate and robust navigation performance for hypersonic air vehicles in prompt global strike applications. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Design a radio-frequency 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 a constructive systems engineering model to assess hypersonic navigation techniques in terms of measures of performance and warfighter utility. Note: This effort was initiated in Project 44SP.		0.000	0.000	1.121	
CONGRESSIONAL ADD: Weather Sensors for Cursor On Target. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Weather Sensors for Cursor On Target. In FY 2010: Not Applicable.		0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Technology.	0.000	0.000							Continuing	Continuing
PE 0603203F/ Advanced Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603253F/ Advanced Avionics Integration.	0.000	0.000							Continuing	Continuing
PE 0602782A/ Command, Control, Communications Technology.	0.000	0.000							Continuing	Continuing
PE 0602232N/ Navy C3 Technology.	0.000	0.000							Continuing	Continuing
PE 0603792N/ Advanced Technology Transition.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F Aerospace Sensors	PROJECT NUMBER 627622

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602601F Space Technology					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	124.910	138.980	104.148						Continuing	Continuing
621010: Space Survivability & Surveillance	48.447	49.377	48.207						Continuing	Continuing
624846: Spacecraft Payload Technologies	23.610	27.986	15.063						Continuing	Continuing
625018: Spacecraft Protection Technology	2.787	7.036	8.026						Continuing	Continuing
628809: Spacecraft Vehicle Technologies	50.066	54.581	32.852						Continuing	Continuing

Note

Note: Funds for the FY 2009 Congressionally-directed Center for Solar Electricity and Hydrogen in the amount of $3.6 million were moved from PE 0602201F, Aerospace Vehicle Technologies to this PE for execution.

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. 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, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	128.397	117.519	104.647	
Current BES/President's Budget	124.910	138.980	104.148	
Total Adjustments	-3.487	21.461	0.000	
Congressional Program Reductions	0.000	-0.042		
Congressional Rescissions	0.000	-0.377		
Total Congressional Increases	0.000	18.280		
Total Reprogrammings	-1.431	3.600		
SBIR/STTR Transfer	-2.056	0.000		

Change Summary Explanation

Changes to this PE since the Previous President's Budget are due to higher Air Force priorities.

Note: In FY 2009, Congress added $2.4 million for Advanced Modular Avionics for Operationally Responsive Space Use, $0.8 million for the Center of Responsive Space Systems, $2.88 million for Multicontinuum Technology for Space Structures, $1.6 million for Radiation Hardened Non-Volatile Memory Technology, $0.8 million for Defensive Counterspace Testbed, $3.0 million for Field Programmable Gate Arrays Mission Assurance Center, $0.8 million for Lightweight, High-Efficient Solar Cells for Spacecraft, $1.6 million for Massively Parallel Optical Interconnects for MicroSatellite Applications, $2.0 million for Nuclear Test Seismic Research, $2.0 million for Reconfigurable Electronics and Non-Volatile Memory Research, and $0.4 million for Shielding Rocket Payloads.

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602601F Space Technology					PROJECT NUMBER 621010	
COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
621010: Space Survivability & Surveillance	48.447	49.377	48.207						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Completed detailed analysis of Solar Mass Ejection Imager. Compiled specifications and guidance for operational heliospheric imager. Initiated measurement of interplanetary magnetic fields using wide-field radio array. Commenced development of magnetic reconnection model to study solar flare initiation and energy storage. Initiated program to test and evaluate empirical flare prediction models based on synoptic data from Air Force and national observatory assets. Completed 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. Coupled radiation belt model to global geospace environment models to increase accuracy and lead time. Validated models for ionospheric penetration by very low frequency (VLF) electromagnetic waves and their injection into the magnetosphere. In FY 2009: Provide scientific and technical support for both optical and radio parts of solar environmental observing network replacement program. Continue exploring techniques for measuring coronal and interplanetary magnetic fields using new wide-field radio arrays. Continue test and evaluation of empirical	6.773	8.865	8.109	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology			PROJECT NUMBER 621010	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2010: Complete trade studies for measuring coronal and interplanetary magnetic fields using new wide-field radio arrays. Assimilate solar vector magnetic field data into solar wind forecast models. Complete development of empirical flare prediction models and start development of physics-based flare forecast models. Analyze energetic particle measurements by recently launched sensors to understand the dynamics of the radiation belts and improve accuracy of space environment specification and forecast models. Begin investigation of new technologies for simulation and mitigation of hazards due to spacecraft electrostatic charging and discharging. Develop the reentry radar profile simulation by collecting data from re-entry vehicle test programs. Upgrade plasma effects simulation upgrade by validating code with flight data.					
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. In FY 2008: Finalized real-time hypertemporal (HT) processing algorithms with optimal parameters for space-based missile launch detection. Developed development third-generation brassboard HT sensor for space-based missile launch detection. Initiated feasibility study of HT applications for technical intelligence from ground, air, and space-based platforms. Used 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. Completed analysis of space data on real world detections of resident space objects with multiple band thermal infrared, visible, and ultraviolet and		13.457	14.451	15.197	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology	PROJECT NUMBER 621010

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
develop models of sensor performance to evaluate capability of space-based sensors. Utilized planned space demonstrations to validate spectral theater surveillance and area search missions and supporting models. Transitioned spectral image processing and exploitation algorithms and related signature databases to government users. Investigated spectral applications for material identification in support of military chemical/ biological weapons detection and identification in the thermal infrared and other bands. 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 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. In FY 2010: Demonstrate aircraft-based detection of large booster missile launch through optically thick sunlit clouds using existing HT image processing. Start focused effort on thermal atmospheric model validation and inversion. Initiate the development of sensor system to characterize space object orbital maneuver based on propulsion signatures. With trade space analyses, down select and develop technical specification of space-based multi-phenomenology SSA sensor payload. Document final results from space experiments in reflective spectral tests. Initiate thermal infrared (IR) imaging spectrometer feasibility for space missions. Employ and refine existing spectral radiative transfer models to evaluate requirements of space-based thermal IR imaging spectrometer to meet anticipated mission needs.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology	PROJECT NUMBER 621010

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Expanded high-latitude data collection to initiate a high-latitude scintillation warning system. Investigated the impact of convection of scintillations to higher latitudes on Ultra High Frequency communication and Global Positioning System (GPS) navigation systems. Investigated HF induced artificial scintillation generation using HAARP. Developed portable ionospheric sensor suite for measuring total electron content and communications/navigation scintillation. Initiated space radar data collection for ionosphere compensation study. Developed scintillation mitigation technology by using metal-oxide space cloud. Developed techniques of analyzing GPS radio occultation data acquired by C/NOFS and Constellation Observing System for Meteorology, Ionosphere and Climate satellites. Incorporated Kalman filter ionospheric model into forecast models and ionospheric warfighter impact products. Conducted statistical analysis of neutral density to improve accuracy of empirical neutral density models for specifying and forecasting neutral density during geomagnetic storms. Implemented algorithm to assess impacts of penetration electric fields on generation of equatorial irregularities. 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. 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 development of physics-based 3-D model of equatorial plasma bubbles into warfighter products and incorporation of ionospheric Kalman filter operational models into equatorial models. In FY 2010: Develop more capable, less costly ground sensors for ionospheric electron density and scintillation parameters utilizing software digital radio technology and newly available satellite signals. Validate C/NOFS instruments and products for operational uses and define follow-on operational mission configuration.	6.981	7.492	9.652	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Implement semi-empirical high-latitude model to couple solar storm effects to the low latitude ionosphere to improve scintillation forecasts. Assess ionospheric effects on the performance of lower frequency space-radar applications such as synthetic aperture radar imagery and coherent-change detection during solar maximum conditions. Quantify the requirements for coupled models. Document improved methods for tailoring the propagation environment (scintillation, scattering, etc.) using the HAARP facilities. Validate scintillation and electron density profiles from radio occultation techniques for operational algorithm development. Expand ground-based sensor network to remote areas supporting research goals and tactical operations. Begin development of space situation awareness testbed.				
MAJOR THRUST: Develop High-frequency Active Auroral Research Program site transmitting and diagnostic instrument infrastructure. In FY 2008: Conducted experimental research with the 3.6 megawatt transmitting array to develop techniques to increase the efficiency of extremely low frequency/very low frequency (ELF/VLF) wave generated in space and initiate research to characterize their interactions with charged particles in the earth's radiation belts. 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. In FY 2010: Enhance wave-particle interactions and amplification research their application to mitigate charged particle effects on space systems and operations with coordinated Demonstration and Science Experiment satellite studies and feedback from physical models.	9.020	9.811	9.259	
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. In FY 2008: Tested and incorporated new research methods for automated processing of increasing numbers of seismic events. Developed long-period regional seismic discrimination, while examining challenges in high-	6.740	6.763	5.990	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology			PROJECT NUMBER 621010	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
frequency regional discrimination. Researched efforts on seismic calibration; seismic detection, location, and discrimination; and observational studies of seismic wave propagation, including propagation in Eurasia. Conducted comprehensive studies to transition the program to meet emerging local seismic monitoring requirements. Designed and conducted theoretical, laboratory, and field studies to support local monitoring. In FY 2009: Develop 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 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. In FY 2010: Refine and expand the applicability of different techniques for automated processing of increasing numbers of seismic events. Continue to conduct detailed research on causes of challenges in high-frequency regional discrimination. Integrate results of seismic calibration and observational studies of seismic wave propagation, including propagation in Eurasia, into a unified model. 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 of new targets. Continue to study improvements in seismic detection, location, and discrimination.					
CONGRESSIONAL ADD: High-frequency Active Auroral Research Program. In FY 2008: Conducted Congressionally-directed effort for HAARP. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		3.129	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: Nuclear Test Seismic Research. In FY 2008: Conducted Congressionally-directed effort for Nuclear Test Seismic Research. In FY 2009: Conduct Congressionally-directed effort for Nuclear Test Seismic Research. In FY 2010: Not Applicable.	2.347	1.995	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0305111F/ Weather Systems.	0.000	0.000							Continuing	Continuing
PE 0305160F/ Defense Meteorological Satellite Program.	0.000	0.000							Continuing	Continuing
PE 0601102F/ Defense Research Sciences.	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603401F/ Advanced Spacecraft Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602601F Space Technology					PROJECT NUMBER 624846	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
624846: Spacecraft Payload Technologies	23.610	27.986	15.063						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Note: In FY 2009: Increase in funding is due to emphasis on SSA technologies. In FY 2008: Investigated spectral agility. Explored field-enhancement technologies. Demonstrated a three-layer single pixel polarimeter. Pursued long-wave infrared (LWIR) superlattice defect reduction and passivation optimization. In FY 2009: Continue investigating spectral agility. Demonstrate tuning from 8 to 12 microns in 1 micron increments. Continue investigating field enhancement technologies. Demonstrate optical amplification 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. In FY 2010: Expand investigation of spectral agility to longer wavelengths. Expand investigation of field enhancement technologies. Complete final demonstration of optical amplification using quantum interference.	3.647	5.242	3.157	

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APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology			PROJECT NUMBER 624846	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop spectral sensing and data exploitation methodologies for military imaging and remote sensing applications. Note: In FY 2009: Increase in funding is due to emphasis on SSA technologies. In FY 2008: Explored the development of a predictive model for advanced imaging concepts. Using the physics-based models, developed an end-to-end capability to predict the performance, benefit, and cost of various sensors for Intelligence, Surveillance, and Reconnaissance (ISR) and SSA applications. 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. In FY 2010: Complete validation of advanced imaging technology predictive models for SSA concepts of operation. Continue to advance simulation capability to enhance accuracy and usability of these models.		0.996	3.170	3.828	
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. Note: In FY 2010, reduction is due to higher Air Force priorities. In FY 2008: Explored 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. 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		3.244	4.396	3.411	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology		PROJECT NUMBER 624846

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
interface modules allocating standardized data messages protocols from sensors for ease device control of sensors and actuators. In FY 2010: Initiate study of phase change materials and begin to develop new classes of electronics that enable efficient analog computing. Develop methods of hardening generation after next electronic devices that enable a factor of two increase in computing performance. Investigate the operation of nanoelectronic devices and incorporate those into new classes of detectors and transistors to enable terahertz operation. Initiate the study of thermoelectric cooling based on advanced Peltier effect materials. Initiate development of radiation hardened plug-and-play interface module to support rapid development or reconfiguration of spacecraft hardware.				
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. Design, develop, test, and evaluate advanced, highly capable decision support and resource management tools and techniques that will enable comprehensive space superiority situational awareness. 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 space control (DSC) technologies. In FY 2008: Completed support of autonomous and responsive space flight experiments with simulations and data validation. Completed extension of the simulation architecture to feed engineering-level data to mission/ campaign models. Developed engineering and military utility models for space superiority analysis of space situational awareness and defensive space control technologies. In FY 2009: Develop engineering, military utility, and cost models for space superiority analysis of SSA detection capabilities. Develop a simulation repository capability for the distributed architecture simulation lab. Begin development of first generation decision support tools for space superiority. Begin development of confidence metrics and software system testbed to score developed tools.	5.627	4.884	4.214	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology			PROJECT NUMBER 624846	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Complete SSA detection analysis tools and begin developing engineering and military utility models for object identification to support SSA and DSC. Incorporate additional tools from external and external sources. Validate tools and code in the simulation repository. Continue development first generation decision support tools for space superiority. Finalize software system testbed. Begin testing of tools on testbed. Begin development of resource management tools for space superiority.					
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. Note: This effort completed in FY 2008. In FY 2008: Integrated single-access laser communications terminal components into multi-access laser communications terminal. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		6.576	0.000	0.000	
MAJOR THRUST: Develop technologies for next-generation space communications terminals and equipment and methods/techniques to enable future space system operational command and control concepts. Note: In FY 2010, reduction is due to higher Air Force priorities. In FY 2008: Not Applicable. In FY 2009: Initiate study of future communication requirements. Develop subsystems for testing and performance enhancements experiments. In FY 2010: Begin development of engineering model of critical technology to satellite communication and ground terminals.		0.000	3.711	0.453	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology			PROJECT NUMBER 624846	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Field Programmable Gate Arrays/ Field Programmable Gate Arrays Mission Assurance Center. In FY 2008: Conducted Congressionally-directed effort for Field Programmable Gate Arrays. In FY 2009: Conduct Congressionally-directed effort for Field Programmable Gate Arrays Mission Assurance Center. In FY 2010: Not Applicable.		1.564	2.992	0.000	
CONGRESSIONAL ADD: Reconfigurable Electronic and Non-Volatile Memory Research. In FY 2008: Conducted Congressionally-directed effort for Reconfigurable Electronic and Non-Volatile Memory Research. In FY 2009: Conduct Congressionally-directed effort for Reconfigurable Electronic and Non-Volatile Memory Research. In FY 2010: Not Applicable.		1.956	1.995	0.000	
CONGRESSIONAL ADD: Radiation Hardened Non-Volatile Memory Technology. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Radiation Hardened Non-Volatile Memory Technology.		0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology	PROJECT NUMBER 624846

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Not Applicable.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603401F/ Advanced Spacecraft Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602601F Space Technology					PROJECT NUMBER 625018	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
625018: Spacecraft Protection Technology	2.787	7.036	8.026						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop key satellite threat warning technologies and tools for high value satellite asset defense. Note: In FY 2009, all thrusts in this Project were combined to better align technology development efforts. In FY 2008: Conducted sensor space flight experiment and analysis. Identified technology transition opportunities and provide associated engineering designs and concepts. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	1.123	0.000	0.000	
MAJOR THRUST: Develop high value space asset defensive capabilities. Note: In FY 2009, all thrusts in this Project were combined to better align technology development efforts. In FY 2008: Developed space experiment using onboard systems or developed proof of concept space experiment to validate concept and multiple use technology. In FY 2009: Not Applicable.	0.951	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology			PROJECT NUMBER 625018	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
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. Note: In FY 2009, all thrusts in this Project were combined to better align technology development efforts. In FY 2008: Transitioned technology to other compatible space systems for multiple uses. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.713	0.000	0.000	
MAJOR THRUST: Develop key satellite threat warning technologies and tools for high value satellite asset defense. Provide high value space asset defensive capabilities through techniques to exploit existing on-board inherent satellite resources, satellite-as-a-sensor, and self-aware satellite technologies. Note: In FY 2009, this thrust was formed by combining previous thrusts to better align technology development efforts. The increases in FY 2009 and out are due to increased Air Force emphasis on defense of space assets. In FY 2008: Not Applicable. In FY 2009: Develop an active and/or passive threat warning sensor for detection of a direct assent or co-orbital vehicle and transition these engineering designs. Identify potential technology options that could provide defensive capability for incorporation into geosynchronous orbit/low earth orbit satellites and complete engineering designs.		0.000	6.238	8.026	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology	PROJECT NUMBER 625018

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Explore capabilities of potential defensive subsystems through laboratory testing. Identify likely transition opportunities and prepare engineering models to assess performance. Develop techniques to exploit existing satellite sensors for dual use defense.				
CONGRESSIONAL ADD: Defensive Counterspace Testbed. In FY 2008: Not Applicable. In FY 2009: Congressionally-directed effort for Defensive Counterspace Testbed. In FY 2010: Not Applicable.	0.000	0.798	0.000	

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0603401F/ Advanced Spacecraft Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology	PROJECT NUMBER 625018

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602601F Space Technology					PROJECT NUMBER 628809	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
628809: Spacecraft Vehicle Technologies	50.066	54.581	32.852						Continuing	Continuing

Note

Note: Funds for the FY 2008 Congressionally-directed funds for the Center for Solar Electricity and Hydrogen in the amount of $2.4 million were moved from PE 0602203F, Aerospace Propulsion, Project 33SP, to this Project, for execution.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Refine and validated cryocooler component and system models with experimental data. Completed theoretical model of multistage cooler energy flows. Investigated thermodynamic loss mechanisms in regenerative cycle cryocoolers through computational fluid dynamics models. Completed definition and commenced 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. Developed advanced concept solar cells traceable to efficiencies greater than 40%. 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	4.354	4.253	4.769	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology			PROJECT NUMBER 628809	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2010: Continue to refine and validate cryocooler component and system models with experimental data. Complete models/validation of pulse tube and start models/validation of inertance tube, regenerator and compressor. Continue to investigate thermodynamic loss mechanisms in regenerative cycle cryocoolers through computational fluid dynamics models, including two stage pulse tube cryocoolers and multistage coolers from 110 Kelvin to 10 Kelvin. Develop subcell technology for thin-film tandem solar cell traceable to greater than 20% efficiency. Continue development of material growth and device structures for solar cells traceable to 40% or higher ultra high efficiency solar cells.					
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. Note: In FY 2009 and out, increase in funding is due to increased emphasis on spacecraft structures. In FY 2008: Completed characterization of thermal protection structural performance. Provided autonomy concepts to support defensive/protection actions by spacecraft. Developed multifunctional structural hardware concepts for space situational awareness, such as structural health monitoring, light occultation by nearby objects, and detection of radio frequency (RF) emissions. Developed system-level architectures for large precision deployable structures. Commenced 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. 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.		10.441	14.594	12.635	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology			PROJECT NUMBER 628809	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Continue development of system-level deployable structures for RF frequencies. Initiate development of integrated thermal management subsystems for responsive space class satellites. Finish and transition advanced estimation algorithms for local situational awareness for next-generation systems. Begin development of guidance, navigation and control algorithms for built around rapid integration and test of satellite hardware. Begin development of advanced data association algorithms for space object tracking. Build representative test cases for data association algorithms. Initiate development of modular plug-and-play spacecraft structural panels to address such concerns as rapid assembly, thermal management, and built-in harnesses and electronics.					
MAJOR THRUST: Develop flight experiments to address key scientific and technological problems in 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. In FY 2008: Completed delivery of all spacecraft payloads. Completed spacecraft assembly, integration and test. Trained mission operations team for on-orbit activities. Prepared science teams for on-orbit operations using simulated data to certify the dissemination and analysis process. In FY 2009: Prepare spacecraft for launch. Complete all spacecraft to launch vehicle interface analysis and approval. Launch spacecraft and commence with Mission Operations. In FY 2010: Integrate spacecraft with separation systems. Integrated spacecraft with launch vehicle. Conduct mission operations rehearsals. Conduct critical design review of next generation spacecraft bus. Begin spacecraft hardware procurement. Continue spacecraft software development.		25.054	23.287	15.448	
CONGRESSIONAL ADD: Deployable Structure Systems for Space. In FY 2008: Conducted Congressionally-directed effort for Deployable Structure Systems for Space.		1.564	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology			PROJECT NUMBER 628809	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Not Applicable. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Microsatellite Target System. In FY 2008: Conducted Congressionally-directed effort for Microsatellite Target System. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.564	0.000	0.000	
CONGRESSIONAL ADD: Mission Design and Analysis Tool. In FY 2008: Conducted Congressionally-directed effort for Mission Design and Analysis Tool. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.489	0.000	0.000	
CONGRESSIONAL ADD: Center for Solar Electricity and Hydrogen. In FY 2008: Conducted Congressionally-directed effort for Center for Solar Electricity and Hydrogen. In FY 2009: Conduct Congressionally-directed effort for Center for Solar Electricity and Hydrogen.		2.347	3.590	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology			PROJECT NUMBER 628809	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Multicontinuum Technology for Space Structures. In FY 2008: Conducted Congressionally-directed effort for Multicontinuum Technology for Space Structures. In FY 2009: Conduct Congressionally-directed effort for Multicontinuum Technology for Space Structures. In FY 2010: Not Applicable.		1.956	2.872	0.000	
CONGRESSIONAL ADD: Shielding Rocket Payloads. In FY 2008: Conducted Congressionally-directed effort for Shielding Rocket Payloads. In FY 2009: Conduct Congressionally-directed effort for Shielding Rocket Payloads. In FY 2010: Not Applicable.		0.341	0.399	0.000	
CONGRESSIONAL ADD: Advanced Modular Avionics for Operationally Responsive Space Use. In FY 2008: Conducted Congressionally-directed effort for Advanced Modular Avionics for Operationally Responsive Space Use. In FY 2009: Conduct Congressionally-directed effort for Advanced Modular Avionics for Operationally Responsive Space Use.		1.956	2.394	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology			PROJECT NUMBER 628809	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Center for Responsive Space Systems. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Center for Responsive Space Systems. In FY 2010: Not Applicable.		0.000	0.798	0.000	
CONGRESSIONAL ADD: Lightweight, High-Efficiency Solar Cells for Spacecraft. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Lightweight, High-Efficiency Solar Cells for Spacecraft. In FY 2010: Not Applicable.		0.000	0.798	0.000	
CONGRESSIONAL ADD: Massively Parallel Optical Interconnects for MicroSatellite Applications. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Massively Parallel Optical Interconnects for MicroSatellite Applications.		0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F Space Technology	PROJECT NUMBER 628809

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Not Applicable.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0603311F/ Ballistic Missile Technology.	0.000	0.000							Continuing	Continuing
PE 0603401F/ Advanced Spacecraft Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602602F Conventional Munitions					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	61.469	57.407	58.289						Continuing	Continuing
622068: Advanced Guidance Technology	18.691	17.933	17.833						Continuing	Continuing
622502: Ordnance Technology	42.778	39.474	40.456						Continuing	Continuing

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. Programs support core technical competencies of target identification and tracking, guidance navigation and control, munition systems, explosives, fuzes, and warheads/damage mechanisms. 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. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	58.632	55.963	60.781	
Current BES/President's Budget	61.469	57.407	58.289	
Total Adjustments	2.837	1.444	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.156		
Total Congressional Increases	0.000	0.000		
Total Reprogrammings	3.628	1.600		
SBIR/STTR Transfer	-0.791	0.000		

Change Summary Explanation

In FY 2009, Congress added $1.6 million for Advanced Nanotube Micro-Munition Weapon Technology Initiative.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602602F Conventional Munitions					PROJECT NUMBER 622068	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
622068: Advanced Guidance Technology	18.691	17.933	17.833						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. (NOTE: Increased funding in FY 2010 due to an increased efforts in Target Identification and Tracking, Signal and Image Processing and related Assessments.) In FY 2008: Tested and demonstrated, in a lab environment, test components for laser ranging seeker to provide "single shot" imaging at useful ranges. Lab tested an optical seeker that uses multi-discriminate signatures to improve targeting of obscured targets. Developed Synthetic Aperture Radar (SAR) system simulation for designing Radar Frequency (RF) seeker technologies analysis. 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 multimode seeker that provides improved performance in two wavelength bands.	6.534	5.080	9.866	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602602F Conventional Munitions		PROJECT NUMBER 622068

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Laboratory demonstration of test components for laser ranging seeker to profile "single shot" images of useful targets. Complete demonstration of optical seeker that uses multi-discriminate signatures to improve targeting obscure targets. Continue development of multimode seeker that provides improved performance using two complimentary wavelength bands. Develop algorithms to use wide field of view optical imager data to augment map-matching techniques, enabling navigation under GPS-denied conditions. Verify polarization theory models through simulation. Conduct tests on optical flow enhanced seeker.				
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. (NOTE: In FY10, the assessments efforts regarding to navigation are included in this thrust.) In FY 2008: Tested navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Applied neuro-physiology of insects to guide small vehicles for moving targets in urban like environments. Evaluated novel navigation system within GPS jamming environments. Investigated using data links to provide target location updates for precision strike against mobile, time sensitive targets. 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. In FY 2010: 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. Continue maturing technologies allowing weapons to communicate in a secure, low probability of detection	3.300	3.455	3.916	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602602F Conventional Munitions			PROJECT NUMBER 622068	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
mode with launch platforms, submunitions and/or ground elements. Integrated demonstration performing a multi-UAV coordinated search and attack on a time critical moving target.					
MAJOR THRUST: Investigate and develop advanced optical and digital processors and target detection, classification, and identification algorithms for improved seeker performance to allow greater air-delivered weapon autonomy. Continue developing highly innovative concepts and approaches in guidance and control. These seekers will deny an enemy the ability to hide or camouflage a target, while also decreasing aircrew workload. (NOTE: Efforts in this thrust were combined with seeker efforts to better align the technologies.) In FY 2008: Verified biomimetic models through simulation. Developed polarization behavior theory models. Developed an optical flow enhanced seeker. 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. In FY 2010: Not Applicable.		3.570	3.851	0.000	
MAJOR THRUST: Using a system approach, investigate and develop weapons by making trades between guidance, navigation and control, and seekers. The thrust will address feasibility by modeling and simulating integrated weapon systems. In FY 2008: Refined the set of interoperable simulations, validating the reusable aspects, to evaluate emerging munitions technologies. Updated and tested multi-spectral phenomenology models and evaluated via synthetic scene simulation. Investigated laser radar (LADAR) scene generation to demonstrate a feasible projection system for hardware-in-the-loop testing. 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		5.287	5.547	4.051	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602602F Conventional Munitions	PROJECT NUMBER 622068

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
results via synthetic scene simulation. Continue the investigation of a LADAR scene generation capability for hardware-in-the-loop testing. In FY 2010: Continue refining the set of interoperable simulations to evaluate emerging munitions technologies. Simulate different highly innovative concepts and approaches in guidance and control technology.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603601F/ Conventional Weapons Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602602F Conventional Munitions					PROJECT NUMBER 622502	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
622502: Ordnance Technology	42.778	39.474	40.456						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. (NOTE: In FY 2010, research activities will be conducted in this thrust were moved to the Munition Integration and the Warheads to better align them with their technical areas.) In FY 2008: Modeled damage to buildings caused by direct weapon effects. Developed capability to apply first principles computational tools to the design and evaluation of new munitions concepts. Identified high payoff technologies for defeating mobile targets. 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. In FY 2010: Not Applicable.	7.810	8.479	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602602F Conventional Munitions			PROJECT NUMBER 622502	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Investigate and develop energetic materials technology that can maximize weapon lethality, while applying appropriate safety and security features. This thrust will formulate, process, characterize,and model energetic materials with potential for weapon applications. (NOTE : Increased funding in FY 2010 is a result of an increased emphasis on technologies in this area.) In FY 2008: Continued developing highly energetic material with twice the power density of conventional explosives by formulating advanced energetic materials. Evaluated the sensitivity and detonation performance and developed design processes for new energetic formulations. Characterized the chemical reaction kinetics of new energetic materials to develop a materials properties database. In FY 2009: Continue developing highly energetic material with twice the power density of conventional explosives by characterizing advanced conventional 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. In FY 2010: Continue developing the materials properties database to develop system level models for predicting initiation. Develop explosive fills that reduce pre-detonation during high "G" loading. Investigate low-density energetic materials for use in micro-munitions. Investigate high-density case materials capable of enhancing warhead performance.		6.000	6.700	9.658	
MAJOR THRUST: Investigate and develop fuzes for air-delivered weapon application. This thrust will provide novel energetic initiation concepts, develop penetration fuzing, develop robust point burst fuzes, and develop predictive models to explore new fuze designs. In FY 2008: Tested a miniaturized fuze to provide safe and arm, burst point sensor, and low power initiator in a four cubic inch package. Static and sled tested a wireless communication system to fuze hard target munitions. Developed waveform agile fuze to defeat smart jamming. Investigated novel warheads to initiate explosives.		5.600	6.000	6.041	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602602F Conventional Munitions			PROJECT NUMBER 622502	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2010: Continue investigating novel methods to initiate explosives, including new modeling and testing techniques. Investigate the mechanical environment that a fuze must survive during hard target penetration events. Explore ground profiling imaging fuze technology. Begin investigating a hardened chip fuze that uses integrated logic.					
MAJOR THRUST: Using a system approach, investigate and develop weapons by making technology trades between fuzes, warheads, and explosives. The thrust will address feasibility of system applications by modeling and simulating integrated weapon systems. (NOTE: Starting in FY 2010, funding for Munition System assessments has been included in this thrust.) In FY 2008: Investigated technologies for miniature cruise missile development. Miniaturized the attack system to communicate target aim point position from behind enemy lines. Field tested a covert video distribution capability to collect and transmit data to coordinate attack of enemy targets. Investigated reaction jet control technology to enable dual role air dominance missile technology. Investigated design of precision guided munitions. In FY 2009: Complete development of third spiral of 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. Conduct research on dispensing technologies for aerospace applications. In FY 2010: Complete investigation of reaction jet control for dual role missile technology. For precision guided munitions, investigate stability during dispense, dispense ejection techniques, and structures to withstand ejection loading. Develop and use a set of interoperable simulations to evaluate emerging munition		14.092	8.800	12.335	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602602F Conventional Munitions		PROJECT NUMBER 622502

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
technologies. Develop and enhance models for micromunitions, penetrators, and counter chemical, biological, radiological, and nuclear effects.				
MAJOR THRUST: Investigate and develop advanced warhead kill mechanisms, such as adaptable warheads, directional control, fragmenting warheads, and application of reactive metals. The enhanced lethality supports smaller munitions with increased aircraft load-out and enhanced effectiveness. (NOTE: Beginning in FY 2010, warhead assessments efforts have been included in this thrust.) In FY 2008: Evaluated selected materials for high-speed penetrating weapons and the hard nose-caps against hard and combination targets. Investigated high strength next generation warhead cases with the eventual goal of terradynamic steering. Evaluated shaped charges to defeat medium and heavy armor. Investigated micro-damage technologies to neutralize electronics with small robotic weapons. Developed a small high velocity unmanned aerial vehicle (UAV) deliverable with strength to defeat hardened targets. Developed a submunition concept that can penetrate hardened target for agent defeat. In FY 2009: Complete evaluation of selected materials for high-speed penetrating weapons and the hard 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. Begin investigations into new mechanisms for defeating agent defeat targets. In FY 2010: Complete investigation of high strength next generation warhead cases with the eventual goal of terradynamic steering. Complete evaluation of shaped charges to defeat medium and heavy armor. Complete investigation of micro-damage technologies to neutralize electronics with air delivered small robotic weapons. Explore compact lethality warhead technologies for use in urban terrain. Begin investigating directional warhead concepts employing reactive fragments to improve standoff kills for non-direct hit encounters. Develop numerical algorithms for material-to-material interface dynamics, loading, and vibration during high	8.100	7.899	12.422	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602602F Conventional Munitions			PROJECT NUMBER 622502	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
speed penetration. Investigate techniques to control, direct, and focus the energy release from explosives in real-time by means of applying small amounts of electromagnetic energy.					
CONGRESSIONAL ADD: Advanced Nanotube Micro-Munition Weapon Technology Initiative. In FY 2008: Conducted Congressionally-directed effort for the Advanced Nanotube Micro-Munition Technology Initiative. In FY 2009: Conduct Congressionally-directed effort for the Advanced Nanotube Micro-Munitions Technology Initiative. In FY 2010: Not Applicable.		1.176	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602602F Conventional Munitions	PROJECT NUMBER 622502

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603601F/ Conventional Weapons Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	55.062	62.701	105.677						Continuing	Continuing
624866: Lasers & Imaging Technology	34.600	36.534	74.139						Continuing	Continuing
624867: Advanced Weapons & Survivability Technology	15.751	19.910	31.538						Continuing	Continuing
6255SP: Laser and Imaging Space Tech	4.711	6.257	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

This program covers research in directed energy technologies, primarily lasers and high power microwaves. In lasers, this research includes moderate to high power laser devices (electric and chemical) and associated optical components and techniques. In imaging, this research includes long-range optical imaging for space situational awareness. In advanced weapons, this program examines technologies such as narrowband and wideband high power microwave devices and antennas. Vulnerability/lethality assessments of representative systems are done for both areas. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	56.915	62.871	90.216	
Current BES/President's Budget	55.062	62.701	105.677	
Total Adjustments	-1.853	-0.170	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.170		
Total Congressional Increases	0.000	0.000		
Total Reprogrammings	-0.717	0.000		
SBIR/STTR Transfer	-1.136	0.000		

Change Summary Explanation

Funding was increased in FY 2009 for additional demonstrations leading to an earlier transition of tactical directed energy weapon technologies. In FY 2010, funds from Project 55SP, Laser and Imaging Space Technology, are being moved to Project 4866, Lasers & Imaging Technology, to better align efforts. Also in FY 2010, significant funding for electric laser, relay mirror, and space situational awareness (SSA) efforts in PE 0603605F, Advanced Weapons Technology, have been moved into this PE to better reflect the actual technology readiness level of the efforts.

C. Performance Metrics

Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY					PROJECT NUMBER 624866	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
624866: Lasers & Imaging Technology	34.600	36.534	74.139						Continuing	Continuing

Note

Note: In FY 2010, the efforts that had been in Project 55SP, Laser and Imaging Space Technology have been moved to this project to allow better integration of directed energy efforts. Also in FY 2010 several electric laser, relay mirror, and space situational awareness efforts in PE 0603605F, Advanced Weapons Technology, have been moved into this project to better reflect the actual technology readiness level of the efforts.

A. Mission Description and Budget Item Justification

This project explores the technical feasibility of moderate to high power lasers, including beam control, for applications such as aircraft protection, force protection, precision engagement, and Global War On Terrorism. It also explores the technical feasibility of long-range optical imaging for space situational awareness. New technologies will be developed and physics based modeling will be conducted that will enable: (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 space surveillance applications, laser beam propagation, and optical pointing and tracking. System concept assessment tools will be developed and used.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop electric laser technologies for airborne tactical and strategic applications. Technologies include fiber, bulk solid state, and semiconductor lasers. Note: In FY 2010, some of the electric laser work in PE 0603605F, Advanced Weapons Technology, has been moved into this thrust to better reflect the actual technology readiness level of those efforts. In FY 2008: Refined laser sources to obtain higher efficiencies and improve ruggedness of designs. Continued development of system-level solutions to aero-optical issues involving airborne tactical laser weapon applications. Continued to scale electric lasers up to the weapons class power level. Refined technologies in effort to obtain suitable parameters in terms of size, weight, efficiency, affordability, reliability, maintainability, supportability, environmental acceptability, and ruggedness for next-generation applications. Performed further lethality assessment studies to assess the effectiveness of the various laser concepts in relevant scenarios. Continued coupon-level and mid-scale demonstration experiments to validate vulnerability assessment models.	15.311	16.378	32.014	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY			PROJECT NUMBER 624866	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Improve design of laser sources for aircraft self-protection. Demonstrate system-level beam control solutions to aero-optical issues of tactical laser weapons applications on airborne platforms. Continue to assess the effectiveness of the various laser concepts in relevant scenarios. Continue to scale electric lasers up to the weapons class power level. Pursue higher power "eye-safer" electric laser concepts. Develop architectures that are suitable in terms of size, weight, efficiency, affordability, reliability, maintainability, supportability, environmental acceptability, and ruggedness for the next-generation applications. Perform damage/vulnerability tests against real or simulated systems. Use test results to verify models and assess laser effectiveness/system vulnerabilities. In FY 2010: Develop technologies, building on previous laser development efforts and incorporating joint service and agency technology advances, to support designing a weapon-class electric laser demonstrator for inclusion on a large aircraft. Enhance design of laser sources for aircraft self-protection and refine system packaging. Improve system architectures that are suitable in terms of size, weight, efficiency, affordability, reliability, maintainability, supportability, environmental acceptability, and ruggedness for the next-generation applications. Develop fiber laser technologies that can be used on a future airborne tactical laser system. Continue damage/vulnerability tests against real and/or simulated systems. Use test results to verify models and assess laser effectiveness/system vulnerabilities.					
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. In FY 2008: Performed engineering analysis on enhanced-performance singlet delta oxygen generator coupled with advanced ejector nozzle concepts for airborne laser applications. Demonstrated advanced fuel chemistries. Continued scaling path demonstrations for electric discharge oxygen-iodine lasers and diode-pumped atomic lasers. In FY 2009: Demonstrate high-performance singlet delta oxygen generator and advanced ejector nozzle concepts for airborne laser applications based on results of previous analysis. Demonstrate scaled electric		5.824	5.204	5.885	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY			PROJECT NUMBER 624866	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
discharge oxygen-iodine lasers and refined diode-pumped atomic laser concepts. Improve modeling and simulation of chemical, hybrid, and diode-pumped lasers. In FY 2010: Transition technologies to improve laser nozzle and generator designs to enhance performance of chemical oxygen-iodine lasers such as those on the Airborne Laser. Continue to improve modeling and simulation of chemical, hybrid, and diode-pumped lasers.					
MAJOR THRUST: Develop optical and imaging technologies including advanced beam control, atmospheric compensation, and pointing and tracking for future optical imaging/laser systems. Develop and demonstrate technologies integrating laser device and associated optical systems. Note: Funding was increased for FY 2009 for additional experiments leading to an earlier transition of tactical laser weapon beam control technologies. In FY 2008: Measured and characterized aero-optical disturbances using integrated adaptive optics hardware in a wind tunnel. Developed and analyzed advanced tactical beam control architectures and critical beam control components. Began development of lightweight optics and advanced tracking techniques and technologies. Assessed alternatives to improve compensation in long horizontal path propagation. Began long-lead parts procurement and subsystem integration of high efficiency sodium beacon adaptive optics system. Continued development of silicon carbide fast steering mirror and complete inner gimbals for tactical relay mirror demonstrator. In FY 2009: Complete initial demonstration of system-level solutions to aero-optical distortions associated with airborne tactical laser weapons systems in wind-tunnel environment. Analyze improvements for consideration of system performance and mission suitability for solid state laser systems on large aircraft. Select improved compensation concepts for laboratory demonstrations of long horizontal path propagation. Begin assembly of major subsystems for the tactical relay mirror demonstrator. Integrate second-generation sodium beacon adaptive optics system with 3.5 meter telescope and prepare for demonstrations of compensated imaging and detection of very dim objects at visible and near-infrared wavelengths. Complete detailed design of a		11.128	14.952	12.604	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY			PROJECT NUMBER 624866	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
demonstrator laser weapon system based on DARPA's High Energy Liquid Laser Area Defense System device. In FY 2010: Continue final tactical relay mirror assembly and begin laboratory testing of major subsystems for the demonstrator. Continue aero-optics wind tunnel tests. Demonstrate in the laboratory selected atmospheric compensation concepts for laboratory long horizontal path propagation.					
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 situational awareness (SSA) systems. Note: In FY 2010, efforts from Project 55SP, Laser and Imaging Space Technology, are being moved to this thrust in order to better align efforts as well as SSA efforts from PE 0603605F, Advanced Weapons Technology, to better reflect the actual technology readiness level of those efforts. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Complete system tests of second-generation sodium beacon adaptive optics system on 3.5 meter telescope and perform demonstrations of compensated imaging and detection of very dim objects at visible and near-infrared wavelengths. Develop, integrate, and test component and system level technologies to advance space situational awareness. Investigate passive and active imaging techniques and demonstrate imaging and non-imaging space-object identification techniques. Develop assessment methodologies by incorporating new experimental data from laser illumination, tracking, and compensated imaging; from results of space materials properties and aging analysis; and from enhanced numerical techniques. Support operational SSA mission planning tools, algorithms, predictive avoidance databases and assessment capabilities with expanded software tools. Develop tools supporting analysis, modeling, and simulation.		0.000	0.000	23.636	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: Ceramics for Next-Generation Tactical Laser Systems	2.337	0.000	0.000	
In FY 2008: Continued development of advanced ceramic materials for solid state lasers.				
In FY 2009: Not Applicable.				
In FY 2010: Not Applicable.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER 624866

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0601108F/ High Energy Laser Research Initiatives.	0.000	0.000							Continuing	Continuing
PE 0602890F/ High Energy Laser Research.	0.000	0.000							Continuing	Continuing
PE 0603444F/ Maui Space Surveillance System.	0.000	0.000							Continuing	Continuing
PE 0603605F/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0603924F/ High Energy Laser Advanced Technology Program.	0.000	0.000							Continuing	Continuing
PE 0602120A/ Sensors and Electronic Survivability.	0.000	0.000							Continuing	Continuing
PE 0602307A/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0602624A/ Weapons and Munitions Technology.	0.000	0.000							Continuing	Continuing
PE 0603004A/ Weapons and Munitions Advanced Technology.	0.000	0.000							Continuing	Continuing
PE 0602114N/ Power Projection Applied Research.	0.000	0.000							Continuing	Continuing
	0.000	0.000							Continuing	Continuing

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification				DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research			R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER 624866	
PE 0602702E/ Tactical Technology.					
PE 0603175C/ Ballistic Missile Defense Technology.	0.000	0.000		Continuing	Continuing
PE 0603883C/ Ballistic Missile Defense Boost Phase Segment.	0.000	0.000		Continuing	Continuing
PE 0602651M/ Joint Non-Lethal Weapons Applied Research.	0.000	0.000		Continuing	Continuing
PE 0603651M/ Joint Non-Lethal Weapons Technology Development.	0.000	0.000		Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000		Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY					PROJECT NUMBER 624867	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
624867: Advanced Weapons & Survivability Technology	15.751	19.910	31.538						Continuing	Continuing

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 disruption and degradation of an adversary's electronic infrastructure and military capability. This research will allow the effect to be applied covertly and with no collateral structural or human damage. 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. Active Denial technologies are also developed and assessed for Air Force non-lethal force protection applications.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Investigate technologies for narrowband and wideband HPM components to support multiple Air Force applications such as the disruption of electronic systems and subsystems. Investigate other unconventional weapon concepts using innovative technologies. Note: FY 2010 funding increase allows enhanced development of HPM technologies. In FY 2008: Continued testing of the compact repetitively pulsed gigawatt-class HPM demonstration unit. Continued to improve the compact HPM source and conformal antenna such that they can be integrated into an airborne platform. Performed design studies for disk generators to further reduce the size of single shot devices. Analyzed the results from the HPM system source code that reflects multiple options for high power subsystem components. Investigated operation of advanced HPM power combining technology. Investigated state-of-the-art components such as fluid-filled HPM switch. In FY 2009: Enhance the compact repetitively pulsed gigawatt-class HPM testbed. Integrate and demonstrate a conformal antenna and command and control system for the compact HPM testbed. Design and develop narrowband HPM components that will be integrated into a demonstration aerial platform. Demonstrate maturing HPM source materials and assess the applicability of solid state subsystem designs supporting ruggedized high power airborne systems. Improve the wideband antenna and high voltage switch and	7.911	11.929	15.329	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY			PROJECT NUMBER 624867	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
demonstrate the effectiveness during field tests. Develop apparatus capable of correctly delivering gas into interaction region of HPM tubes. Investigate HPM concepts related to cyber warfare and determine new HPM waveforms that can be optimized for a counter-electronics application. Implement the enhanced options for high power subsystem components based on the results of the HPM system source code. Design/develop state-of-the-art energy storage power components. In FY 2010: Develop and evaluate components of the narrowband HPM aerial demonstrator. Investigate electromagnetic interference/electromagnetic capability of narrowband HPM components. Continue investigations of integrating a wideband HPM system into small unmanned aerial vehicles. Conduct laboratory experiments using new types of HPM waveforms for counter-electronics applications. Develop refined and specific application of flux-compression generators. Advance and utilize state-of-the-art energy storage components within pulsed-power components.					
MAJOR THRUST: 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. In FY 2008: Incorporated elemental modeling into predictive code for use in targeting and war gaming. Continued susceptibility testing of electronic targets. Applied hardening techniques and technology to identified platforms. Identified and mitigated HPM susceptibility for military systems of interest to HPM sources. Continued to investigate battle damage assessment technologies for use with HPM. Applied virtual modeling for HPM system enhancement. Continued to investigate and integrate improved material models into HPM tube simulations. Continued development of automatic design enhancement. In FY 2009: Apply physics-based understanding and models to predict target effects and incorporate capability into an engagement model. Continue verification and validation of engagement model software. Expand microwave effects mitigation effort to harden additional Air Force systems against red systems, including air defense systems. Verify linkages between components in an HPM system. Integrate, verify, and improve		5.863	6.030	6.816	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER 624867

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
material models for field and thermal emission models. Begin upgrade of infrastructure to accommodate HPM effects testing at frequencies as high as 35 gigahertz. In FY 2010: Expand modeling capabilities to include accurate prediction of effects with minimal inputs. Continue effects mitigation efforts on systems of interest and expand into new systems to include modern tactical aircraft. Unite multiple HPM-related models for end-to-end simulation and design efforts. Complete infrastructure updates to enable representative effects testing on subsystems to cover all HPM frequencies currently of interest.				
MAJOR THRUST: Investigate advanced technologies that support force protection tactical applications, including non-lethal counterpersonnel applications from an airborne platform. Note: Funding was increased in FY 2010 to speed development of a next generation Active Denial demonstrator. In FY 2008: Continued development of test stand for full power non-lethal source for long range/airborne applications. Transitioned work on millimeter wave diagnostic techniques to testing and evaluation community. Began physics code modification to facilitate more compact next generation nonlethal system development. In FY 2009: Complete main design work for test stand for full power non-lethal radiating system demonstration. Continue development of advanced modeling codes that incorporate ability to model harmonic sources. Complete next phase of harmonic source development study. In FY 2010: Continue design and research work for test stand for full power non-lethal radiating system demonstration for airborne application. Continue development and use of advanced modeling codes that incorporate ability to model harmonic sources. Develop key source and thermal subsystems technologies for next generation Active Denial demonstrator. Begin harmonic source development.	1.977	1.951	9.393	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER 624867

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Systems Technology.	0.000	0.000							Continuing	Continuing
PE 0603605F/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0602120A/ Sensors and Electronic Survivability	0.000	0.000							Continuing	Continuing
PE 0602624A/ Weapons and Munitions Technology	0.000	0.000							Continuing	Continuing
PE 0602114N/ Power Projection	0.000	0.000							Continuing	Continuing
PE 0602651M/ Joint Non-Lethal Weapons Applied Research.	0.000	0.000							Continuing	Continuing
PE 0603851M/ Nonlethal Weapons	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER 624867

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY					PROJECT NUMBER 6255SP	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
6255SP: Laser and Imaging Space Tech	4.711	6.257	0.000						Continuing	Continuing

Note

Note: In FY 2010, the efforts in this project are being moved to Project 4866, Lasers & Imaging Technology to better align efforts.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Investigated the bandwidth, movement, and resolution limits of various adaptive optics concepts, correlated the attributes to user needs to include aero-optic compensation. Demonstrated the functionality of sharing each sub-aperture of a phased array for both transmit and receive. Demonstrated high resolution phased array imaging. Demonstrated spatial heterodyne interferometry in a coherent beam combining concept. In FY 2009: Continue testing of electrostatic deformable mirror technologies to determine maturity and utility for Air Force applications. Develop and demonstrate a high energy fiber laser phased array transceiver system level brassboard concept that includes high resolution pupil plane imaging, coherent beam combining, shared transmit/receive sub-apertures, and initial acquisition, pointing, and tracking investigation. In FY 2010: This thrust has been moved to Project 4866, Laser and Imaging Technology, in order to better align efforts.	2.394	2.544	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY			PROJECT NUMBER 6255SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Assess the vulnerability of U.S. satellites to the effects of high-energy laser weapons and update catalogued satellites. In FY 2008: Explored new methods to develop and apply improved algorithms and hardware for satellite characterization and assessment. Continued to refine assessment methodology by incorporating new data into modeling tools, including results of laser illumination, tracking, and compensated imaging; and applying new techniques. Assessed the survivability and vulnerability of evolving aerospace systems to the effects of directed energy weapons. Integrated developed space material properties and aging effects data and algorithms into assessments. Continued 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. 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 support of operational mission planning tools, algorithms, predictive avoidance, and space situational awareness by updating and transitioning databases and assessment capabilities. Integrate and test advanced optical and infrared sensor systems with 3.5 meter telescope and second generation sodium beacon adaptive optics for dim space object tracking, detection, and imaging. In FY 2010: This thrust has been moved to Project 4866, Laser and Imaging Technology, in order to better align efforts.		2.317	3.713	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER 6255SP

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603444F/ Maui Space Surveillance Systems.	0.000	0.000							Continuing	Continuing
PE 0603605F/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0601108F/ High Energy Laser Research Initiatives.	0.000	0.000							Continuing	Continuing
PE 0602890F/ High Energy Laser Research.	0.000	0.000							Continuing	Continuing
PE 0603924F/ High Energy Laser Advanced Technology Program.	0.000	0.000							Continuing	Continuing
PE 0603883C/ Ballistic Missile Defense Boost Phase Segment.	0.000	0.000							Continuing	Continuing
PE 0602120A/ Sensors and Electronic Survivability.	0.000	0.000							Continuing	Continuing
PE 0602307A/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0602624A/ Weapons and Munitions Technology.	0.000	0.000							Continuing	Continuing
PE 0603004A/ Weapons and Munitions Advanced Technology.	0.000	0.000							Continuing	Continuing
	0.000	0.000							Continuing	Continuing

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification				DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research			R-1 ITEM NOMENCLATURE PE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER 6255SP	
PE 0602114N/ Power Projection Applied Research.					
PE 0602702E/ Tactical Technology.	0.000	0.000		Continuing	Continuing
PE 0603175C/ Ballistic Missile Defense Technology.	0.000	0.000		Continuing	Continuing
PE 0603883C/ Ballistic Missile Defense Boost Phase Segment.	0.000	0.000		Continuing	Continuing
PE 0602651M/ Joint Non-Lethal Weapons Applied Research.	0.000	0.000		Continuing	Continuing
PE 0602651M/ Joint Non-Lethal Weapons Applied Research.	0.000	0.000		Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize the efforts and elimi	0.000	0.000		Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	119.545	115.559	0.000						Continuing	Continuing
624519: Communications Technology	32.111	36.975	0.000						Continuing	Continuing
624594: Information Technology	31.257	32.470	0.000						Continuing	Continuing
625581: Command and Control (C2) Technology	39.216	36.152	0.000						Continuing	Continuing
6266SP: Space Optical Network Tech	16.961	9.962	0.000						Continuing	Continuing

Note

Note: In FY 2010, efforts in this PE move to PE 0602788F, Dominant Information Technology.

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. 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, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	121.417	109.492	123.122	
Current BES/President's Budget	119.545	115.559	0.000	
Total Adjustments	-1.872	6.067	0.000	
Congressional Program Reductions	0.000	-0.020		
Congressional Rescissions	0.000	-0.313		
Total Congressional Increases	0.000	4.800		
Total Reprogrammings	-0.848	1.600		
SBIR/STTR Transfer	-1.024	0.000		

Change Summary Explanation

Note: In FY 2009, Congress added $2.8 million for Compact Laser Terminal for Airborne Network Centric Warfare, and $2.0 million for Cyber Attack Mitigation Lab. Additionally, Congress added $1.6 million for Space Qualification of the Common Data link in PE 0602204F, Sensor Technology, which has been transfered to this PE for execution.

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications					PROJECT NUMBER 624519	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
624519: Communications Technology	32.111	36.975	0.000						Continuing	Continuing

Note

Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Connectivity and Protection Tech.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop assured and survivable information and networking technologies enabling worldwide command, control, surveillance, reconnaissance, and exploitation operations for the Air Force. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 1. In FY 2008: Developed policy-based network management technologies for real-time network response to changes in INFOCON levels. Developed airborne content-based delivery networking (CBDN), synergistic with the Joint Tactical Radio System Wideband Networking Waveform's Network Service Layer, and applied to extremely dynamic airborne nets. Designed and developed airborne network modeling and simulation technology. Initiated design and development of cognitive networking technology that senses operating environment, learns application requirements, and intelligently adapts network protocols. Initiated 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. Developed and completed intelligent network management agents designed to	9.477	9.996	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications			PROJECT NUMBER 624519	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
monitor the airborne domain's handling of the flow of information from platform to platform through various interconnected communication nodes and links. Initiated 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. In FY 2009: Complete development of airborne CBDN, synergistic with the Joint Tactical Radio System Wideband Networking Waveform's Network Service Layer, and applies 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, internet protocol 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 mission critical enterprise to resist new attacks. Initiate development of secure data sharing to prevent the disclosure of sensitive information to untrustworthy users. In FY 2010: Not Applicable.					
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. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 2.		4.244	3.704	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications	PROJECT NUMBER 624519

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Completed demonstration of adaptively combined multi-dimensional (space, time, frequency, coding, polarization) transmission techniques that enable high bandwidth information transmission and exploitation capabilities. Completed demonstration of multi-mode, multi-function, sense-and-adapt air-mobile communications capability to dynamically alter communications methods under fast-changing environment. Developed quantum key distribution and cryptography technologies to effect ultra-secure communications for wired and wireless networks. Initiated 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. Initiated investigation to provide assured access (anti-jam) covert high capacity spectrum dominance for global networking while denying the adversary the same. Initiated development of scaleable video compression schemes which dynamically trade-off bandwidth and quality based upon the priority of the required information. Initiated the development of advanced, automated, network and bandwidth management technologies to move, manage, and process information in real-time for the warfighter. 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 assured 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. In FY 2010: Not Applicable.				
MAJOR THRUST/CONGRESSIONAL ADD: Develop critical information transmission technologies to permit the seamless integration of aerospace weapon systems' C2, intelligence, surveillance, and reconnaissance data/information. Note: This effort includes Congressional Add funding of $2.0 million in FY 2008, and $2.8 million in FY 2009. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 3.	3.425	4.281	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications	PROJECT NUMBER 624519

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Completed development, test, and assessment of exploratory radio frequency and optical information transfer technologies. Explored 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. Conducted the Congressionally-directed Compact Laser Terminal for Airborne Network Centric Warfare to develop a compact, low power consumption wavelength tunable laser transmitter for free-space optical communications in an airborne network. In FY 2009: Complete exploring 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. Conduct the Congressionally directed Compact Laser Terminal for Airborne Network Centric Warfare effort to develop acompact, low power comsumption wavelenght tunable laser transmitter for free-space optical communications in an airborne network. In FY 2010: Not Applicable.				
MAJOR THRUST/CONGRESSIONAL ADD: Develop cyber operations technologies for enabling worldwide command, control, communications, and intelligence. Note: Increased funding in FY 2008 and FY 2009 is due to emphasis on offensive cyber operations. Note: This effort includes Congressional Add funding of $1.9 million in FY 2008, and $2.0 million in FY 2009. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 5. In FY 2008: Completed development of techniques for defining rapid defensive courses-of-action (COA) to counter adversary information warfare attacks. Developed defensive techniques for wireless, mobile, and embedded systems. Demonstrated detection and eradication techniques for malicious code. Completed development of advanced correlation fusion techniques for defensive course of action analysis. Completed efforts in self-healing systems. Initiated 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. Developed a prototype that is 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	13.397	17.398	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications	PROJECT NUMBER 624519

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
improving the overall defenses of the airborne network. Initiated development of access techniques allowing "cyber paths" to protected adversary information systems through a multiplicity of attack vectors. Initiated development of stealth and persistence technologies enabling continued operation within the adversary information network. Initiated 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. Initiated 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. Conducted Congressionally-directed Cyber Attack Mitigation Lab effort to develop malware detection and reverse engineering in order to provide a significant increase in understanding of malware as well as protection to the GIG and other critical infrastructures. 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 QoS and QoA integration to the information system enterprise doing 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 development of stealth and persistence technologies enabling network discovery, propagation to new locations, and data exfiltration/infiltration. 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. Conduct the Congressionally directed Cyber Attack Mitigation Lab effort. In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: Adaptive Optics Lasercom System. In FY 2008: Continued the integration of the laser communications terminal into a Wescam turret and support an air to ground flight test scheduled for mid-2008. The flight test validated the laser beam pointing,	1.568	0.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
acquisition, and tracking; the laser communication terminal operation at altitude; and the performance of the adaptive optics in an airborne environment. In FY 2009: Not Applicable. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Space Qualification of the Common Data Link. In FY 2008: Not Applicable. In FY 2009: Conduct the Congressionally-directed Space Qualification of the Common Data Link. In FY 2010: Not Applicable.		0.000	1.596	0.000	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603789F/ C3I Advanced Development.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications					PROJECT NUMBER 624594	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
624594: Information Technology	31.257	32.470	0.000						Continuing	Continuing

Note

Note: In FY 2010, these efforts move to PE 0602788, Project 5318, Operational Awareness Tech, and Project 5317, Information Decision Making Tech.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop innovative multi-sensor collaborative fusion technologies in a fully distributed air and space environment. Note: In FY 2010, this effort moves to PE 0602788F, Project 5318, Major Thrust 1. In FY 2008: Evaluated fusion management and advanced the state-of-the-art in track-to-track fusion techniques. Developed the process of probabilistic identification though the use of multi-source fusion. Increased probabilistic confidence through the inclusion of higher-level fusion techniques in the situational assessment and process refinement area. Developed techniques to dynamically update advanced reasoning fusion engines to adapt to changing threat conditions. Developed intelligence, surveillance, and reconnaissance management techniques that optimize the fusion process for identification and continuous tracking of military significant threats. Evaluated network centric approaches to provide distributed fusion techniques to the warfighter. Developed new track algorithms that combine traditional kinematic associations	6.867	6.836	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Developed 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). Initiated 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 examined include machine-to-machine automated multi-INT fusion, long term automated tracking and ID of nominated targets, and automated/adaptive pattern recognition. Initiated investigation of Fusion of CybINT (Cyber Intelligence) with traditional INTs. 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 through 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, and 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). 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. In FY 2010: Not Applicable.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications			PROJECT NUMBER 624594	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. Note: In FY 2010, this effort moves to PE 0602788F, Project 5318, Major Thrust 2. In FY 2008: Completed 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. 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 awareness and understanding. Developed inferencing techniques for reasoning about the situation and for predicting adversarial intent and threat possibility. Developed a dynamic real-time information management capability with the objective of decreasing the execution speeds of embedded HPC and enterprise infospheres by 100X. Initiated development of multi-source and automated recognition techniques to support analysis of current situations. Initiated 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 assets. Initiated development of technology demonstration plans for active intelligence, surveillance, and reconnaissance (ISR) defense on wired networks to perform an adaptive response to multiple, coordinated, sustained attacks. Initiated 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. Initiated research to achieve the capability to analyze multiple courses of action (COA) having cascading effects in near real-time. The capability is 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. 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		7.117	9.119	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
an autonomous set of cooperative agents under positive control to defend mission critical Air Force assets. Initiate development of technology demonstration plans for active ISR defense on wired networks to perform an adaptive response to multiple, coordinated, and sustained attacks. Continue research to achieve the capability to analyze multiple COAs 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. Complete the development of a set of algorithms that can automatically develop, reason, and 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). In FY 2010: Not Applicable.				
MAJOR THRUST: Develop automatic and dynamically reconfigurable, affordable, scalable, distributed petaflop processing technologies for real-time C2 global information systems. Note: In FY 2010, this effort moves to PE 0602788F, Project 5317, Major Thrust 1. In FY 2008: Initiated implementation of architectural features for cognitive information processing. Developed algorithms for next generation information technologies for C2 systems. Developed and characterized high performance computers for quantum computing applications. Developed and characterized the next generation of high performance computers. Developed a prototype chip that contains a hybrid architecture design; which will provide an emulation capability for large scale cognitive architecture evaluations. Initiated the development of the tools, techniques, standards, and technologies required to build highly complex software-intensive systems. 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	6.100	7.015	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop modeling and simulation technologies for the next generation of planning, assessment, and execution environments. Note: In FY 2010, this effort moves to PE 0602788F, Project 5318, Major Thrust 5. In FY 2008: Completed demonstrations of advanced modeling and simulation technologies to support next generation planning, assessment, and execution environments. Demonstrated adversarial behavior models and modeling techniques for courses of action (COA) assessment and prediction. Conducted concept demonstrations of integrated interaction and assessment of friendly versus adversary courses of action. Demonstrated a prototypical dynamic situation assessment and prediction system. Investigated advanced concepts to provide approaches for a modeling toolset that enables the warfighter to build composable simulations. Initiated investigation of ability to forecast potential adversaries and events based on indications of known evidence and projected known and/or anticipated threat(s). 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		2.713	2.262	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
investigation of ability to forecast potential adversaries and events based on indications of known evidence and projected known and/or anticipated threat(s). In FY 2010: Not Applicable.					
MAJOR THRUST: Develop real-time embedded information system technologies for complex, time-critical, embedded systems to enable affordable design and development of state-of-the-art hardware and software, innovatively incorporate new capabilities, reactively adapt to multiple missions and changing environments, verify, validate, and assure functionality and integrity, and facilitate rapid insertion to support real-time, collaborative operations within a net-centric enterprise. Note: In FY 2010, this effort moves to PE 0602788F, Project 5317, Major Thrust 2. In FY 2008: Developed dynamically reconfigurable aerospace systems using adaptive computing techniques to support image/video processing and data compression. Developed affordable, high assurance architecture components for real-time embedded systems supporting Multi-Level Security/Multiple Single Levels of Security (MLS/MSLS) and mixed criticality. 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. In FY 2009: Complete development of dynamically reconfigurable aerospace systems using adaptive computing techniques to support image/video processing and data compression. Complete development of affordable, high assurance components for real-time embedded systems supporting MLS/MSLS and mixed criticality. Complete development of methods of computation and computing processes using biologically-inspired and biologically-based computation for embedded systems application. Complete development of power-aware, polymorphic aerospace systems for mission-aware computing. In FY 2010: Not Applicable.		2.624	1.948	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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: In FY 2010, this effort moves to PE 0602788F, Project 5318, Major Thrust 3. In FY 2008: Developed multi-intelligence toolsets for the processing, exploitation, and dissemination of actionable intelligence. Developed 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. Developed 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. 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 malicious software (malware), system self-optimization/diagnosis/recovery, and the development of self-correcting watermarked code and data for trusted and optimized computing. In FY 2010: Not Applicable.	5.836	5.290	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603789F/ C3I Advanced Development.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications					PROJECT NUMBER 625581	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
625581: Command and Control (C2) Technology	39.216	36.152	0.000						Continuing	Continuing

Note

Note: In FY 2010, this effort moves to PE 0602788F, Project 5316, Info Mgmt and Computational Tech.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Investigate and develop technologies for the rapid development and application of next generation knowledge bases for aerospace C2 systems. Note: In FY 2010, this effort moves to PE 0602788F, Project 5318, Major Thrust 4. In FY 2008: Developed 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. Investigated and developed 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. Developed a prototype that	6.391	4.876	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. Initiated development of automated capture and self-organization of knowledge in globally distributed repositories. 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. In FY 2010: Not Applicable.					
MAJOR THRUST: Investigate, analyze, and develop technologies for automatic rapid reconfiguration of distributed intelligent information systems to varying crisis levels faced by the Expeditionary Aerospace Force. Note: In FY 2010, this effort moves to PE 0602788F, Project 5316, Major Thrust 2. In FY 2008: Completed 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. Developed advanced interactive displays suitable for rapid 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. Developed technologies for a holistic tool set that commanders can use to probe, study, analyze, visualize, reason, and predict activities in and around the battlespace. Developed an advanced mission planning process that will provide a self-healing, secure, rule-based automatic scheduling process that resembles an auction style planning capability. Initiated development of capabilities to be more agile within a net centric enabled environment. Developed timely option generation selection and coordination capabilities that account for uncertainty and missing and erroneous information,		10.069	9.906	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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). Developed dynamic workflow and workload management capabilities to manage the command and control constellation of resources. 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, 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 humans (analytical reasoning). Continue the development of dynamic workflow and workload management capabilities to manage the command and control constellation of resources. In FY 2010: Not Applicable.				
MAJOR THRUST: Investigate and develop technologies to securely share information via publish, subscribe, and query with coalition partners as part of the overall Global Information Grid approach. Sharing of information is in part a function of secure sharing, but is also a function of the managing of the information in assessing the trustworthiness of the information and its markup. Note: In FY 2010, this effort moves to PE 0602788F, Project 5316, Major Thrust 1. In FY 2008: Researched and developed cross-domain information sharing to include collaborative monitoring and management of multi-national enterprise resources. Developed techniques and tools that will ensure	7.628	6.627	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
availability, integrity, and survivability of information within a coalition net-centric environment. Investigated and prototyped 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. Developed publish/subscribe/query technologies for application to a content-based delivery networking (CBDN) system for intelligent network management of user information. Initiated development of technologies to systematically integrate information sources across COI's. 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 CBDN system for intelligent network management of user information. In FY 2010: Not Applicable.					
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. Note: In FY 2010, this effort moves to PE 0602788F, Project 5316, Major Thrust 3. In FY 2008: Investigated application of decision support sciences and advanced decision-making concepts to C2 activities within a Coalition AOC. Developed intelligent information systems capable of supporting joint/coalition C2 for various missions in a dynamically changing environment. Developed tools to increase situational awareness and understanding through intelligent information processing. Applied system-of-systems and federation-of-systems engineering in the creation of joint C2 capabilities. Explored the application of intelligent software agents as virtual battle staff members to enhance various C2 processes. Completed		7.791	6.717	0.000	

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APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications			PROJECT NUMBER 625581	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
the development and demonstration of an effects-based dynamic tasking process enabled by dynamically accessible data and information services. Initiated 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 uses causal reasoning, linking effects to actions to desired end-state, develops non-deterministic, non-linear causal linkages, and is capable of reasoning through uncertainty and ambiguity. Initiated research to achieve the ability to predict the current and future impact of an adversary cyber attack on Air Force information systems. Developed effects-based defense models to help predict the first and second order impact of cyber attacks on an information system/mission. Developed cyber defense containment scenarios that minimize current and future adversary impact to net-centric warfare (NCW) mission. 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 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 uncertainty and ambiguity. In FY 2010: Not Applicable.					
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. Note: In FY 2010, this effort moves to PE 0602788F, Project 5316, Major Thrust 2.		1.996	1.891	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications			PROJECT NUMBER 625581	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: 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. Developed technology and techniques to monitor, obtain feedback, and assert control over the COI Infosphere. Investigated the security policy enforcement between COI Infospheres at various levels of security classification. 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. Initiated decentralization and fault tolerant information management services for the tactical environment. Initiated development of information transformation services and adaptive information management services that learn, self-configure, self-manage, and are self-healing. Initiated 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. 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 services that learn, self-configure, self-manage, and are self-healing. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop distributed collaboration technologies, advance collaboration science, virtual environments, and predictive simulation tools to facilitate the development and fielding of next generation		5.341	6.135	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications	PROJECT NUMBER 625581

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
operational collaborative decision support systems. Note: In FY 2010, this effort moves to PE 0602788F, Project 5316, Major Thrust 5. In FY 2008: Developed advanced information technologies for collaborative decision-making and knowledge management in support of capability-based planning and next generation planning, execution, and assessment environments. Prototyped 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. Initiated 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. Supported context aware collaborative user interfaces and semantic interoperability. In FY 2009: Complete 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. Complete prototyping 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. In FY 2010: Not Applicable.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications	PROJECT NUMBER 625581

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603617F/ C3 Applications.	0.000	0.000							Continuing	Continuing
PE 0303401F/ Communications-Computer Systems (C-CS) Security RDT&E.	0.000	0.000							Continuing	Continuing
PE 0603789F/ C3I Advanced Development.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications					PROJECT NUMBER 6266SP	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
6266SP: Space Optical Network Tech	16.961	9.962	0.000						Continuing	Continuing

Note

Note: In FY 2010, this effort moves to PE 0602788, Project 5315, Connectivity and Protection Tech.

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 (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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and assess optical network technologies for application in the space environment. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 7. In FY 2008: Completed demonstration of 16 x 16 optical data router and optical backbone interface chips for integration with on board Integrated Core Processor. Initiated design and development of 40 channel multi-wavelength optical network for on-board air and space applications. In FY 2009: Continue development of 40 channel multi wavelength optical network for on-board air and space applications. In FY 2010: Not Applicable.	1.497	2.967	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications			PROJECT NUMBER 6266SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop and assess existing and emerging Optical CDMA and WDM modulation schemes and protocols for use in space-based optical networks. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 7. In FY 2008: Designed and developed optical burst switching and optical label switching protocols for applicability to air and space-based optical networks. Completed flight demonstration of industry standard single mode optical communications bus interface chip for airborne platforms. In FY 2009: Initiate flight demonstration of multi-gigabit, multi-wavelength optical communications bus interface chip for space and air platforms. In FY 2010: Not Applicable.		3.521	1.798	0.000	
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. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 8. In FY 2008: Completed the characterization of the combiner RF/laser communications brassboard. Designed and developed higher throughput RF waveform data link technology for operation under adverse weather conditions. Conducted flight demonstration of combined RF/laser communications brassboard in cooperation with the demonstration of advanced airborne sensor technologies. In FY 2009: Complete the development and start the characterization of higher throughput RF waveform data link technology for operation under adverse weather conditions. Initiate the design of an integrated RF/laser communications airborne qualifiable brassboard. In FY 2010: Not Applicable.		11.943	5.197	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications	PROJECT NUMBER 6266SP

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603789F/ C3I Advanced Development.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology					
COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	0.000	0.000	115.278						Continuing	Continuing
625315: Connectivity and Protection Tech	0.000	0.000	44.625						Continuing	Continuing
625316: Info Mgt and Computational Tech	0.000	0.000	33.816						Continuing	Continuing
625317: Information Decision Making Tech	0.000	0.000	16.940						Continuing	Continuing
625318: Operational Awareness Tech	0.000	0.000	19.897						Continuing	Continuing

Note

Note: Prior to FY 2010, efforts in this PE were performed in PE 0602702F, Command, Control and Communication.

A. Mission Description and Budget Item Justification

This program develops enterprise-centric information technology for the Air Force. Advances in enterprise-centric information technologies 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 Operational Awareness Tech project develops technologies that improve and automate their capability to generate process, manage, fuse, exploit, interpret, and disseminate timely and accurate information. The Connectivity and Protection Tech project provides the technologies for: multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques as well as technologies that successfully deter any adversary from attacking computer systems anytime, anywhere while allowing access to, presence on, manipulation of and operational effects of adversary computer systems. In addition, 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. The Info Mgmt and Computational Tech project will provide advances in robust information management and dissemination technologies to ensure the delivery of high-quality, timely, secure information to the warfighter and develop technologies to produce both advanced on-demand computational processing and computer architectures with greater capacity and sophistication for addressing dynamic mission objectives under constraints imposed by AF systems. The Decision Making and Response Tech project develops the technology necessary to support the commander and staff's ability to command all viable options to achieve desired effects across the full spectrum of operations. This program is in Budget Activity 2, since it develops and demonstrates the technical feasibility and military utility of evolutionary and revolutionary technologies.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	**R-1 ITEM NOMENCLATURE** PE 0602788F Dominant Information Technology

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	0.000	0.000	0.000	
Current BES/President's Budget	0.000	0.000	115.278	
Total Adjustments	0.000	0.000	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	0.000		
Total Congressional Increases	0.000	0.000		
Total Reprogrammings	0.000	0.000		
SBIR/STTR Transfer	0.000	0.000		

Change Summary Explanation

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology					PROJECT NUMBER 625315	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
625315: Connectivity and Protection Tech	0.000	0.000	44.625						Continuing	Continuing

Note

Note: Prior to FY 2010, efforts in this PE were performed in PE 0602702F, Command, Control and Communications, Project 4519 and Project 66SP.

A. Mission Description and Budget Item Justification

The Air Force requires technologies that enable assured, worldwide communications for an agile Expeditionary Aerospace Force (EAF). These communication technologies will provide en-route and deployed reachback communications for distributed collaborative military operations. A rapidly deployed EAF requires assured connectivity with reliable, responsive, affordable information exchange via all available communications media and across all domains - air, space, and cyber. This project provides the technologies for: secure, self-configuring, self-healing, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques; agile, dynamic policy based network management capabilities; and modular, programmable, low-cost software radios. This project also develops both the technology base for the next generation of ultra-wide bandwidth, multi-channeled, air and space-based communications networks on and between platforms using the technologies for implementing photonic chip scale optical Code Division Multiple Access (CDMA) and Wavelength Division Multiplexed (WMD) transceivers and prototype networks associated with the advanced fiber optic, and the 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. In addition, the Air Force requires technologies to deliver a full range of options in cyberspace at par with air and space dominance in each of the areas of cyber attack, cyber defense, and cyber support to achieve the strategic capability of cyber dominance. This project provides the technologies required to successfully deter any adversary from attacking computer systems anytime, anywhere by ensuring the AF's ability to: 1) access, maintain presence on, and deliver effects to adversary systems, 2) detect, defend, and respond to attacks on friendly computer systems as well as provide forensic analysis concerning those attack attempts, and 3) provide cyber situational awareness to AF commanders.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop assured and survivable information and networking technologies enabling worldwide command, control, surveillance, reconnaissance, and exploitation operations for the Air Force. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 4519. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	0.000	0.000	7.013	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology			PROJECT NUMBER 625315	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Initiate development of low probability of intercept, low probability of detection waveform for hand held multi data rate radio. Design smart power control and advanced field programmable gate arrays with reduced size, weight, and power for hand held multi-data rate radio. Continue development of a resilient and self-regenerating information 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.					
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. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 4519. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Design and demonstrate an automated reasoning network management agent system based off of semantic web technologies capable of reasoning out suggested conclusions to detected network events rather than presenting only raw data to an information manager. Complete demonstration of assured access, anti-jam communications capability that combines multi-dimensional (space, time, frequency, coding) transmission techniques to mitigate and survive in multipath fading, interference, and jamming environments via spectrum sense and adapt techniques. Complete design and demonstration of cognitive networking technology that senses operational environment, discerns application requirements, and adapts network protocols/resources. Complete development of advanced, automated, wireless airborne networking and comm link emulation capability for the assessment and evaluation of communications algorithms in a virtual military comm environment. Initiate in-house and university development of next generation advanced networking		0.000	0.000	6.227	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology		PROJECT NUMBER 625315		
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
technologies for distributed military operations in an airborne environment ensuring reliable information exchange across all domains of air, space, and cyber.					
MAJOR THRUST: Develop cyber defense and supporting technologies to detect, defend, and respond to attacks on friendly computer systems as well as provide forensic analysis concerning those attack attempts, and to provide cyber situational awareness to AF commanders. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 4519. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Continue to develop defensive techniques for wireless, mobile, and embedded systems. Initiate vulnerability analysis and threat identification for emerging commercial wireless standards. Complete investigation of fusion of CybINT with traditional INTs and use of CybINT collection technologies to increase situation awareness of enterprise systems and malicious activities occurring therein. 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, and sustained attacks.		0.000	0.000	1.630	
MAJOR THRUST: Develop offensive cyber operations technologies to access, maintain presence on, and deliver effects to adversary systems. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 4519. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		0.000	0.000	15.311	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology			PROJECT NUMBER 625315	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Continue development of information system access methods and development of propagation techniques. Continue development of stealth and persistence technologies. Initiate development of the capability to exfiltrate information from adversary information systems for generation of actionable CybINT. Continue technology development for preparation of the battlefield and increased situational awareness and understanding. Continue development of technology to deliver D5 effects. Initiate efforts to develop autonomic technologies for operating within adversary information systems. Initiate development of techniques for covert communication among agents operating within adversary information systems. Initiate analysis of proprietary hardware and software systems to identify viable means of access and sustained operations within the same. Initiate efforts to develop a pub/sub architecture for exchange and exfiltration of information while operating within adversary information systems. Demonstrate ability to identify foreign languages as a part of a CybINT capability.					
MAJOR THRUST: Investigate the range of cyber technologies as needed to achieve information and cyber dominance. Provide development of technologies, through various methods including in-house experimentation and university research, to achieve the capability of avoiding diverse threats to blue force information systems in the cyber domain. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 4519. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Initiate development of technologies to support a polymorphic cyber infrastructure that avoids exposure to threats and can proactively escape from incoming threats before they affect friendly information systems. Initiate development of techniques to support evasion and escape maneuvers in cyberspace. Initiate development of technology to provide a trusted verification of information system hardware resources. Initiate the development of remote rendering services and thin client technology to protect end user information		0.000	0.000	5.181	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology		PROJECT NUMBER 625315

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
systems from network-delivered threats. Initiate challenge problem and university research investigations for development of cyber domain capabilities supporting AF information systems.				
MAJOR THRUST: Develop methods and technologies for controlled operation of information systems during attacks and fault conditions and technology for guaranteeing the correctness of data and executable codes. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 4519. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Initiate development of assured end-to-end quality of service (QoS) and quality of information assurance (QoIA) integration to the information system during attacks and faults to provide the ability to degrade gracefully in a controlled trade space. Initiate development of novel software protection techniques to guarantee the incorruptibility of data and executable codes.	0.000	0.000	2.052	
MAJOR THRUST: Develop and assess optical network technologies for application in the space environment including existing and emerging Optical CDMA and WDM modulation schemes and protocols for use in space-based optical networks. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 66SP. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Design and develop a flight test system with a Dense Wavelength Division Multiplexed (DWDM) broadcast architecture consisting of an optical backbone with single mode fiber optic cable, tunable laser transmitters, 32 channel receivers, a passive star coupler, and expanded beam connectors. Continue development of 40 channel multi wavelength optical network for on-board air and space applications.	0.000	0.000	4.839	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology	PROJECT NUMBER 625315

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 66SP. In FY 2008: Not Applicable. In FY 2008: Not Applicable. In FY 2010: Complete characterization of higher throughput RF waveform data link technology. Initiate development of prototype hardware and software with advanced coding and higher order modulation for higher throughput RF waveform generation.	0.000	0.000	2.372	

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/Not applicable	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification			DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology		PROJECT NUMBER 625316

COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
625316: Info Mgt and Computational Tech	0.000	0.000	33.816						Continuing	Continuing

Note

Note: Prior to FY 2010, efforts in this PE were performed in PE 0602702F, Command, Control and Communications, Projects 4519 and 5581.

A. Mission Description and Budget Item Justification

The Air Force requires the capability to maximize the value, sharing, management, and use of its information and information assets in achieving its mission objectives as the importance of information grows in the current net centric environment. Technology development 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. Advances in robust information management focus on quality of service and flow of information within the enterprise, information transformation and brokering, secure information sharing across and among domains, and collaboration of workflow within the enterprise. Technologies addressed in this project include the ability to globally share, discover, and access information across organizational, functional, and coalition boundaries and between and among domains, the timely delivery of information to tactical assets, the tailoring and prioritization of information based on mission needs and importance, and the scaling, robustness, and collaboration features required of the AF net-centric information management environment. In addition, the Air Force requires the development of superior, intelligent, on-demand computing to enable information superiority. Technology development in this project focuses on producing: 1) computer architectures with greater capacity and sophistication for addressing constrained, dynamic mission objectives, 2) "game-changing" computing power to the warfighter, 3) disruptive computing technology power at the edge and the power behind grid services, and 4) interactive and real-time computing improving the usability of high performance computing to the AF. It includes technologies in computational sciences and engineering, computer architectures and software intensive systems.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Investigate and develop technologies to securely share information via publish, subscribe, and query with coalition partners as part of the overall brokered federated Global Information Grid. Sharing of information is in part a function of secure sharing, but is also a function of the managing of the information in assessing the trustworthiness of the information and its markup. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 5581. In FY 2008: Not Applicable.	0.000	0.000	10.477	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology	PROJECT NUMBER 625316

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Not Applicable. In FY 2010: Continue research into cross domain information sharing technologies. Investigate cognitively assisted information technologies to provide automated assistance to the current labor-intensive process of human review and release of sensitive information to other security domains and enclaves. Develop secure cross domain discovery and sharing of web services. Complete development of content-based dissemination mechanisms and quality of service provisioning. Initiate development of novel information management techniques as applied to all domains through in-house and university research leading to enhanced information flow across the net-centric assets of the GIG.				
MAJOR THRUST: Investigate and develop technologies to implement agile, high performance, secure, scalable, and survivable information management and dissemination services to enable a Global Information Grid-based COI Infosphere. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 5581. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop service components that provide information management sharing mechanisms as infrastructure components within a service oriented architecture (SOA). Collections of the service components may be assembled to establish a robust and reliable information sharing substrate eliminating application complexity and management responsibility. Develop mechanisms to federate and share information across disbursed locations and establish the means to maintain provenance and authoritative control over the information. Develop information sharing mechanisms to efficiently share and synchronize dynamic information sources where information changes are in the seconds and require secure disperse dissemination. Develop prioritized queuing mechanisms to maximize value of delivered information based upon its context. Demonstrate decentralized information management through advanced infospherics research. Initiate development of tactical information dominance capabilities that include UAS, "wide-body" assets and high-altitude platforms.	0.000	0.000	13.877	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology			PROJECT NUMBER 625316	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop collaborative services technologies and virtual environments to facilitate the development and fielding of next generation operational collaborative decision support systems. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 5581. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Based on study results, begin development of an information service orchestration framework that leverages open system standards and technologies to implement workflow capabilities that can adapt the execution of information services to the changing requirements of dynamic military environments.		0.000	0.000	0.660	
MAJOR THRUST: Develop automatic and dynamically reconfigurable, affordable, scalable, distributed peta-flop processing technologies for real-time global information systems. Support need for petaflops embedded on-demand processing throughput. Develop scalable architectures to support micro to macro autonomous platforms. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 4594. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Continue the development of the tools, techniques, standards, and technologies required to build highly complex software-intensive systems. Continue the 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. Evaluate current processor functionality and identify functionality necessary for system on chip capability. Initiate architectures for cognitive systems. Identify nodal design hierarchy for modular system. Initiate scalable quantum information		0.000	0.000	4.099	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology	PROJECT NUMBER 625316

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
science testbed for optimized information searching and processing. Develop algorithms and simulations of select computationally challenging and relevant problems. Initiate development of next generation advanced computing techniques enabling superior information processing for AF warfighters through in-house and university research.				
MAJOR THRUST: Develop secure, manageable cross domain discovery services that allow appropriate access to approved services outside of existing domain. Develop a programmable extensible architecture for pods for net-centric exploitation and tracking comprising the software and hardware infrastructure for a net-centric system to support real-time tactical collection, exploitation, and C2 suitable for employment in a UAV or targeting pod. Architecture will support reconfigurable sensor suites, self-aware networks, federated information spaces, and embedded high speed processing and archiving. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 5581. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Initiate investigation of current LDAP best practices and design multi-level LDAP capability. Investigate current state of the art in web services discovery. Identify best of breed capabilities and apply security to fulfill cross-domain discovery requirements. Develop flexible sensor interfaces to support rapid sensor replacement and configuration without modification of backend hardware or software infrastructure. Evaluate impact of emerging tactical radios. Develop prioritized delivery mechanisms by integrating information management and networking complementary capabilities.	0.000	0.000	1.881	
MAJOR THRUST: Develop the architectural mechanisms that form the basis for predictable software and high assurance systems. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 5581. In FY 2008: Not Applicable.	0.000	0.000	2.822	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology	PROJECT NUMBER 625316

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Not Applicable. In FY 2010: Initiate development and design of a modular trusted computing base architecture composed of the foundational hardware and software necessary to ensure overall system security. Enhance system performance of multi-core and multi-threaded microprocessors through resiliency mechanisms.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/Not applicable	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology					PROJECT NUMBER 625317	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
625317: Information Decision Making Tech	0.000	0.000	16.940						Continuing	Continuing

Note

Note: Prior to FY 2010, efforts in this PE were performed in PE 0602702F, Command, Control and Communications, Project 5581.

A. Mission Description and Budget Item Justification

The Air Force requires advances in technologies enabling the effective execution of military objectives will vastly improve the ability to support the commander and staff's ability to command all viable options to achieve desired effects 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 through stability operations). Technology development in this project addressing this requirement include anticipatory decision support and course of action development, planning, scheduling and assessment, and the real time effective portrayal of complex data sets.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop next generation monitoring, planning, and assessment technologies and tools enabling distributed aerospace commanders to efficiently and collaboratively develop effects based campaigns. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 5581. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Continue development of decision support sciences applications and advanced decision-making concepts for activities focused on integrated command and control (C2). Demonstrate intelligent information systems capable of supporting joint/coalition C2 associated with a specific mission in a dynamically changing environment. Continue to develop tools to increase situational awareness and understanding of the air, space, and cyberspace domains through intelligent information processing. Continue the application of system-of-systems and federation-of-systems engineering in the creation of joint/integrated C2 capabilities. Complete the exploration the application of intelligent software agents as virtual battle staff members to enhance various	0.000	0.000	3.714	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology	PROJECT NUMBER 625317

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
C2 processes. Initiate investigation of intelligent software agents for autonomous AOC/platform operations. 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. Develop the capability to accomplish causal reasoning, linking effects to actions to desired end-state, and capable of reasoning through uncertainty and ambiguity. Continue research to achieve the capability to analyze multiple courses of action (COA) having cascading effects in near real-time. Develop the capability to mix kinetic and non-kinetic options, incrementally 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. Initiate investigation into wargaming technologies to support the rapid analysis of crisis-action plans or courses of action. Initiate in-house and university development of next generation planning, decision making, and course of action tools supporting the commander's ability to exercise a wide range of command and execution options for AF forces.				
MAJOR THRUST: Investigate, analyze, and develop technologies for automatic rapid reconfiguration of distributed intelligent information systems to varying crisis levels faced by the Expeditionary Aerospace Force. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 5581. In FY 2009: Not Applicable. In FY 2009: Not Applicable. In FY 2010: 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. Continue development of capabilities to be more agile within a net centric enabled environment. Develop the ability for timely kinetic/non-kinetic option generation, selection, and coordination capabilities that account for uncertainty and missing and erroneous information, and supports	0.000	0.000	10.412	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology	PROJECT NUMBER 625317

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
intuitive decision making process between man and machine collaborating on complex, dynamic problems. Continue the development and demonstration of a decision workflow and workload management capabilities to manage the command and control constellation of resources focused on specific missions.				
MAJOR THRUST: Investigate, analyze, and develop technologies for planning, executing, and assessing seamless integrated command and control to achieve desired effects globally. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 5581. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Investigate processes and technologies and recommend solutions to enable the Air and Space Operations Center (AOC) to conduct kinetic/non-kinetic Monitor, Assess, Plan, and Execute (MAPE) while under degraded conditions due to cyber attacks. Design and develop an experimentation environment and conduct scenario based integrated C2 studies. Develop and evaluate measures of effectiveness (MOEs) and measures of performance (MOPs) for key attributes associated with integrated C2. Investigate methods to seamlessly move between geospatial and non-geospatial data to enhance situational awareness and enable integrated decisions over the air, space, and cyber domains. Develop applications for visualizing and exploring remotely accessed heterogeneous data in to a common operating picture of the battlespace. Initiate an effort to develop an integrated task order synchronizing air, space, and cyberspace capabilities to achieve desired effect.	0.000	0.000	2.814	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology	PROJECT NUMBER 625317

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/Not applicable	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology					PROJECT NUMBER 625318	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
625318: Operational Awareness Tech	0.000	0.000	19.897						Continuing	Continuing

Note

Note: Prior to FY 2010, efforts in this PE were performed in PE 0602702F, Command, Control and Communications, Project 4594.

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 provides not only a network-centric, collaborative intelligence analysis capability that enables the fusion of multi-intelligence and sensor sources to provide timely situation awareness, understanding, and anticipation of the threats in the battle space, but also the advanced, novel exploitation technologies needed to intercept, collect, locate, and process both covert and overt raw data from intelligence and sensor sources. It leads the research, discovery, and development of technology that enables the fusion of multi-intelligence sources to provide accurate object tracking and ID, situation awareness, understanding, and anticipation of the threats in the battle space (air, ground, space, and cyber). It also leads in the development of advanced exploitation technologies to maximize the intelligence gained from our adversaries in the areas of spectral detection and geolocation, signal recognition and analysis, and the data tagging, tracking, and tracing via the insertion of secure, imperceptible signal embedding for future fusion and understanding of the information.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop innovative multi-sensor collaborative fusion technologies in a fully distributed environment. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 4594. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Extend and mature models to reflect real Multi-INT data effects. Demonstrate capability on real data sets. Complete Hybrid Multi-INT association algorithms based on contextual knowledge/advanced reasoning. Explore tracking techniques in combination with Multi-INT feature data to improve the probability of correct association and extend track lifetimes for moving targets. Continue to Investigate Impacts of Resource Management. Examine and demonstrate distributed multi-platform fusion utilizing resource allocation, mission	0.000	0.000	6.016	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology	PROJECT NUMBER 625318

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
planning, and cueing. Develop the capability to utilize detected movement information and social network analysis to define and exploit the structure and behavior of the enemy.				
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. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 4594. In FY 2008: Not Applicable. In FY 2008: Not Applicable. In FY 2010: Complete development of automated reasoning techniques for assessing current situations using adversarial capabilities. Initiate development of techniques for analyzing and assessing activities to support situation assessment. Initiate in-house and university research dealing with Level 1 - 4 Fusion using multi-source intelligence and sensor feeds to advance the AF capability to anticipate the variety of threats from the ground, air, and cyber domains.	0.000	0.000	1.513	
MAJOR THRUST: 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: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 4594. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Continue the development and evaluation of watermarking techniques, extending to include streaming data. Extend multimedia data technologies for additional applications, with a focus on net-	0.000	0.000	3.648	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology			PROJECT NUMBER 625318	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
centric technology applications. Focus on information provenance. Analyze and develop audio processing technologies in the area of vocal tract modification. Developed foundations, technology, and algorithms to enable improvements to intelligence, surveillance, and reconnaissance missions. Further provide laboratory functionality to develop real time, tactical information exploitation software for test and evaluation using operational data. Initiate the development and evaluation of algorithms to identify and classify an application layer (request/reply) messaging protocol (termed MODBUS), that provides client/server communication between devices connected on different types of buses or networks, for supervisory control and data acquisition (SCADA) systems, including field and protocol specific characteristics. Extend and incorporate these characteristics into lab-generated test sets. Initiate in-house and university research in advanced exploitation techniques that maximize the AF ability to gather, process, and display information from multi-INT sources identifying threats to warfighters across the physical and cyber domains.					
MAJOR THRUST: Research and evaluate capabilities for reasoning and learning, text understanding, link and group discovery, and advanced analysis for situation awareness and understanding. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 4594. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop and complete a framework for document level discourse analysis and inference based on information extracted from the text and ontological world knowledge. Develop and complete techniques for analysis of audio sources as well as alternate sources by applying social network analysis metrics to determine high value targets. Initiate research on dynamic networks over time for simultaneous analysis of large volumes of streaming data with archived relational information.		0.000	0.000	2.049	
		0.000	0.000	6.671	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology	PROJECT NUMBER 625318

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop modeling and simulation technologies for the next generation of planning, assessment, and execution environments. Note: Prior to FY 2010, efforts were conducted in PE 0602702F, Project 4594. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Complete 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 development to model and explore policy actions and reactions taken by the different modeled entities activities. Initiate development of the nation state model (to include both the physical and social subsystems). Provide initial capability for the decision maker to understand varying degree of effects, their interactions and interdependencies caused by "Blue's" potential actions. Initiate verification and validation for integration of the various frameworks. Investigate development of techniques that are capable of developing/managing sets of adversary futures. Complete investigation of ability to forecast potential adversaries and events based on indications of known evidence and projected known and/or anticipated threat(s). Initiate development of an integrated set of possible combinations of adversary COAs based on the adversary's abilities and capabilities to perform activities associated with various domains.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/Not applicable	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not applicable

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602788F Dominant Information Technology	PROJECT NUMBER 625318

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602890F High Energy Laser Research					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	48.588	49.268	52.754						Continuing	Continuing
625096: High Energy Laser Research	48.588	49.268	52.754						Continuing	Continuing

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 delivery, precision target engagement, 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/little 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 an impact on multiple HEL systems and multiple Service missions while complimenting Service/Agency programs that are directed at specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, free electron lasers, laser beam control, and laser lethality mechanisms. 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. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	49.949	49.449	53.561	
Current BES/President's Budget	48.588	49.268	52.754	
Total Adjustments	-1.361	-0.181	0.000	
Congressional Program Reductions	0.000	-0.047		
Congressional Rescissions	0.000	-0.134		
Total Congressional Increases	0.000	0.000		
Total Reprogrammings	0.000	0.000		
SBIR/STTR Transfer	-1.361	0.000		

Change Summary Explanation

Not Applicable.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602890F High Energy Laser Research

C. Performance Metrics
Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602890F High Energy Laser Research					PROJECT NUMBER 625096	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
625096: High Energy Laser Research	48.588	49.268	52.754						Continuing	Continuing

A. Mission Description and Budget Item Justification

N/A

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Advance solid-state laser development. In FY 2008: Directed the 100 kilowatt Joint High Power Solid State Laser (JHPSSL) project. Provided for independent government-sponsored measurements of the 100 kilowatt laser(s). Completed preliminary plan for a joint high-power electric laser product improvement program that emphasizes efficiency, affordability, and ruggedization. In FY 2009: Participate in the 100 kilowatt JHPSSL laboratory demonstrations. Verify performance through independent government-sponsored measurements. Initiate a joint-high power electric laser product improvement program that emphasizes efficiency, affordability, and ruggedization. In FY 2010: Conduct a joint-high power electric laser product improvement program. Begin translation of efficiency improvements into size, weight and packing reductions.	11.881	8.500	12.652	
MAJOR THRUST: Mature solid state laser device technologies that will provide improve system level performance. In FY 2008: Developed technologies that will lead to improved fieldability, serviceability, and ruggedness. Developed power scaling architectures that maintain good beam quality. Established a versatile testbed enabling demonstration of laser module combination concepts. Conducted an industry proposal call for FY 2008, awarded eight new projects.	8.480	9.308	9.514	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602890F High Energy Laser Research			PROJECT NUMBER 625096	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Continue power scaling architecture development with good beam quality and reduced size and weight. Improve the efficiency and reliability of diode pump sources. Continue testing of laser module combination concepts on the testbed. Conduct Service and Agency proposal call for FY 2009. In FY 2010: Combine high performance single modules in optimum module combination schemes to demonstrate the path to weapons-class scaling. Continue development of high reliability diode pump sources. Investigate eye-safer laser technologies. Conduct an industry proposal call for FY 2010.					
MAJOR THRUST: Investigate new technologies that have revolutionary potential for HEL applications. In FY 2008: Explored short-pulse laser technology and potential applications. Conducted an industry proposal call for FY 2008, awarded four new projects in optical materials development and novel beam control configurations. In FY 2009: Develop materials with improved thermo-mechanical properties. Demonstrate short pulse laser technologies in a laboratory environment. Demonstrate novel beam control concepts. Investigate new laser materials for direct lasing in different wavelength regimes. Conduct a Service and Agency proposal call for FY 2009. In FY 2010: Incorporate new materials into a laser device and demonstrate properties in terms of wavelength selection, thermal handling, and overall laser efficiency. Scale short pulse laser technologies for military applications. Conduct an industry proposal call for FY 2010.		3.480	4.520	4.595	
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.		7.777	7.210	4.265	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602890F High Energy Laser Research	PROJECT NUMBER 625096

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: With the Navy, investigated the development path for scaling to a 100 kilowatt laboratory demonstration. Conducted an industry proposal call for FY 2008, awarded five new projects. In FY 2009: With the Navy, complete prototype FEL demonstration activities and investigate the development path for scaling to a 100 kilowatt lab demonstration, with emphasis on technologies that can support 1 megawatt future FEL performance. Conduct a Service and Agency proposal call for FY 2009. In FY 2010: With the Navy, continue to investigate the development path for scaling to a 100 kilowatt laboratory demonstration, with emphasis on technologies that can support a megawatt class future FEL. Conduct an industry proposal call for FY 2010.				
MAJOR THRUST: Conduct technology experiments to select promising chemical generator and chemical regeneration technologies that can be scaled for weapons application. Conduct advanced research in scaling of diode-pumped alkali lasers. In FY 2008: Demonstrated closed-cycle chemical oxygen iodine laser devices. Explored novel concepts on electric-gas phase laser generation. Conducted an industry proposal call for FY 2008, awarded four new projects. In FY 2009: Investigate alternate chemical processes and high pressure operations concepts. Develop concepts for gas lasing materials with high efficiency. Investigate power scaling potential of direct excitation gas lasers. Conduct a Service and Agency proposal call for FY 2009. In FY 2010: Demonstrate efficient production of chemical laser fuels. Demonstrate concepts on electric-gas phase laser generation. Conduct an industry proposal call for FY 2010.	5.220	6.160	6.146	
MAJOR THRUST: Develop technology to support high performance beam control systems and integrated demonstrations.	7.750	9.490	9.662	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602890F High Energy Laser Research	PROJECT NUMBER 625096

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Explored advanced component and control techniques for difficult environments, such as high speed flight, high turbulence, and extended ranges. Conducted an industry proposal call for FY 2008, awarded eight new projects. In FY 2009: Develop/provide beam control technology options for laser weapon use on multiple platforms (aircraft, ground vehicles and shipboard systems). Investigate technologies to compensate for negative effects of atmosphere and platform vibration. Conduct a Service and Agency proposal call for FY 2009. In FY 2010: Demonstrate efficient production of chemical laser fuels. Demonstrate concepts on electric-gas phase laser generation. Conduct an industry proposal call for FY 2010.				
MAJOR THRUST: Develop a lethality database, and integrate into a systems-level architecture plan and lethality models. In FY 2008: Integrated lethality data into campaign-level HEL system models. Conducted laser vulnerability experiments on materials, components, and targets. Developed laser systems inputs for the Joint Munitions Effect Manual. In FY 2009: Develop databases that will be accepted by the HEL community, and integrate in validated models for laser systems designers. Conduct laser vulnerability experiments on materials, components, and targets. Update laser systems inputs for the Joint Munitions Effect Manual. In FY 2010: Integrate lethality data into campaign-level HEL system models. Conduct laser vulnerability experiments on materials, components, and targets. Update laser systems inputs for the Joint Munitions Effect Manual.	4.000	4.080	4.068	
	0.000	0.000	1.852	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602890F High Energy Laser Research	PROJECT NUMBER 625096

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Maintain and evaluate high-fidelity engineering models for HEL system scenario evaluation and incorporation into the HEL toolkit. Provide for HEL system modeling for into mission-level wargaming activities. Note: In FY 2010, this effort transitions from PE 0601108F, High Energy Laser Research Initiatives to this PE. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Complete, test and demonstrate solid state laser model. Complete HEL system scenario model and demonstrate engagement applications.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602890F High Energy Laser Research	PROJECT NUMBER 625096

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601108F/ High Energy Laser Research Initiatives.	0.000	0.000							Continuing	Continuing
PE 0603444F/ Maui Space Surveillance System.	0.000	0.000							Continuing	Continuing
PE 0603605F/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0603924F/ High Energy Laser Advanced Technology Program.	0.000	0.000							Continuing	Continuing
PE 0603883C/ Ballistic Missile Defense Boost Phase Segment.	0.000	0.000							Continuing	Continuing
PE 0602605F/ Directed Energy Technology.	0.000	0.000							Continuing	Continuing
PE 0602307A/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0602114N/ Power Projection Applied Research.	0.000	0.000							Continuing	Continuing
PE 0602120A/ Sensors and Electronic Survivability.	0.000	0.000							Continuing	Continuing
PE 0603004A/ Weapons and Munitions Advanced Technology.	0.000	0.000							Continuing	Continuing
PE 0602702E/ Tactical Technology.	0.000	0.000							Continuing	Continuing

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification			DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research			R-1 ITEM NOMENCLATURE PE 0602890F High Energy Laser Research		PROJECT NUMBER 625096
PE 0603175C/ Ballistic Missile Defense Technology.	0.000	0.000		Continuing	Continuing
PE 0602651M/ Joint Non-Lethal Weapons Applied Research.	0.000	0.000		Continuing	Continuing
PE 0603651M/ Joint Non-Lethal Weapons Technology Development.	0.000	0.000		Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance process to harmonize efforts and eliminate du	0.000	0.000		Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	61.166	62.676	37.901						Continuing	Continuing
632100: Laser Hardened Materials	22.835	24.087	24.278						Continuing	Continuing
633153: Non-Destructive Inspection Development	7.709	8.163	1.655						Continuing	Continuing
633946: Materials Transition	11.040	15.936	9.582						Continuing	Continuing
634918: Deployed Air Base Demonstrations	13.760	11.287	2.386						Continuing	Continuing
6377SP: Advanced Space Materials	5.822	3.203	0.000						Continuing	Continuing

Note

Note: FY 2008 funding totals include $5.437 million in supplemental funding. In FY 2010, funds from Project 77SP have been moved to Project 2100 within this Program Element to more accurately align efforts.

A. Mission Description and Budget Item Justification

This program develops and demonstrates materials technology for transition into Air Force systems. The program has five 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; (4) airbase operations technologies including deployable base infrastructure, force protection, and fire fighting capabilities; and (5) advanced materials for space 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, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603112F Advanced Materials for Weapon Systems

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	54.871	41.926	45.030	
Current BES/President's Budget	61.166	62.676	37.901	
Total Adjustments	6.295	20.750	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.170		
Total Congressional Increases	5.437	23.720		
Total Reprogrammings	2.090	-2.800		
SBIR/STTR Transfer	-1.232	0.000		

Change Summary Explanation

In FY 2009, Congress added $2.72 million for EMI Grid Fabrication Technology, $2.4 million for Aircraft Evaluation Readiness Initiative (AERI), $0.8 million for Materials Integrity Management Research for Air Force Systems, $4.0 million for Metals Affordability Initiative, $2.4 million for Sewage-Derived Biofuels Project, $4.8 million for Silicon Carbide Electronics Material Producibility Initiative, $0.8 million for Sonic Infrared Imaging Technology Development, $1.0 million for Strategic Biofuel Supply Program, and $2.0 million for Body Armor Improved Ballistic Protection.

C. Performance Metrics

Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems					PROJECT NUMBER 632100	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
632100: Laser Hardened Materials	22.835	24.087	24.278						Continuing	Continuing

Note

Note: Funds from Project 77SP have been moved to Project 2100 within this Program Element to more accurately align efforts.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and demonstrate advanced materials technologies that enhance hardening for sensors, avionics, and components to increase survivability and mission effectiveness of aerospace systems. Note: The increase in funding in FY 2010 is a result of funds being moved from Project 77SP to better align efforts. In FY 2008: Demonstrated mature hardening materials technology for an Air Force tactical system. Characterized and incorporated candidate dual band limiter materials for tactical systems. Demonstrated protection strategies for large format charge coupled devices (CCD). In FY 2009: Transition mature hardening materials technology for an Air Force tactical system. Demonstrate performance of dual band limiter materials in tactical systems. In FY 2010: Investigate performance of dual band limiter materials in tactical systems. Demonstrate protection strategies for large format multi-chip CCDs. Fabricate and demonstrate solid state limiter and filter technology for protection of space systems. Evaluate materials survivability for space environments. Analyze the effect of laser energy on optical materials and electro-optical sensors and space structural materials.	17.665	17.834	20.111	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems			PROJECT NUMBER 632100	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: 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. In FY 2008: Validated performance of state-of-the-art agile filters and optical power limiters in a system configuration. Optimized agile filter and optical limiter devices for Air Force applications. 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. In FY 2010: Integrate fixed optical coatings within visor applications for demonstration.		5.170	6.253	4.167	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER 632100

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0603231F/ Crew Systems and Personnel Protection Technology.	0.000	0.000							Continuing	Continuing
PE 0604706F/ Life Support Systems.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Tri-Service Laser Hardened Materials and Structures Gr	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER 632100

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems					PROJECT NUMBER 633153	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
633153: Non-Destructive Inspection Development	7.709	8.163	1.655						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Developed NDI/E approaches to extend the life of fracture-critical gas turbine engine components. In FY 2009: Demonstrate NDI/E approaches to extend the life of fracture-critical gas turbine engine components. In FY 2010: Validate NDI/E approaches to extend the life of fracture-critical gas turbine engine components.	0.530	0.527	0.200	
MAJOR THRUST: Develop and demonstrate advanced inspection technologies supporting low-observable (LO) systems to enhance affordability and ensure full performance and survivability. In FY 2008: Developed and demonstrated multiuse, multiplatform LO NDI/E hand tool that meets user requirements. In FY 2009: Develop and demonstrate a multiuse, multiplatform LO NDI/E hand tool that meets user requirements.	0.291	0.339	0.786	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems			PROJECT NUMBER 633153	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Transition a common, multiuse, multiplatform, handheld LO NDI/E point inspection tool/sensor system.					
MAJOR THRUST: 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: In FY 2009, this effort terminates due to higher Air Force priorities. In FY 2008: Validated NDI/E technologies to meet emerging inspection requirements for aging aircraft and develop processes. In FY 2009: Transition application-focused NDI/E technologies to meet emerging inspection requirements for aging aircraft. In FY 2010: Not Applicable.		1.780	1.727	0.000	
MAJOR THRUST: 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. In FY 2008: Developed optimal sensing approaches for real-time health monitoring of high-temperature protection systems and characterized power scavenging and signal transmission issues. Developed improved, smaller smart sensor technologies for wiring health analysis. Developed data fusion to be used with field-level inspection tools for assessing the structural health of airframes. 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		1.515	1.580	0.669	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems			PROJECT NUMBER 633153	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
sensor technologies for wiring health analysis. Transition total field-level inspection tool for assessing the structural health of airframes. In FY 2010: Develop and demonstrate optimal sensing approaches for real-time health monitoring of high-temperature protection and advanced material systems and characterize power scavenging and signal transmission issues. Validate smart sensor technologies for wiring health analysis. Validate field- and depot-level inspection tools for assessing the structural health of airframes.					
CONGRESSIONAL ADD: Aircraft Evaluation Readiness Initiative (AERI). In FY 2008: Conducted Congressionally-directed effort for AERI. In FY 2009: Conduct Congressionally-directed effort for AERI. In FY 2010: Not Applicable.		1.942	2.394	0.000	
CONGRESSIONAL ADD: Continuous Integrated Vehicle Health Monitoring System. In FY 2008: Conducted Congressionally-directed effort for Continuous Integrated Vehicle Health Monitoring System. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.165	0.000	0.000	
CONGRESSIONAL ADD: Materials Integrity Management Research for Air Force Systems. In FY 2008: Conducted Congressionally-directed effort for Materials Integrity Management Research.		0.486	0.798	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER 633153

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Conduct Congressionally-directed effort for Materials Integrity Management Research for Air Force Systems. In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: Sonic Infrared Imaging Technology Development. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Sonic Infrared Imaging Technology Development. In FY 2010: Not Applicable.	0.000	0.798	0.000	

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER 633153

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems					PROJECT NUMBER 633946	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
633946: Materials Transition	11.040	15.936	9.582						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and demonstrate advanced materials and processing technologies for air vehicles and subsystems to enhance the lift, propulsion, low-observable performance, power generation/management, and overall affordability of air vehicles. In FY 2008: Validated materials-damage predictive approaches for engine health determination and life extension capability. Transitioned advanced materials and materials process capabilities for component-level demonstrations of power generation materials for airborne directed energy weapons. Transitioned 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. Transitioned flexible/lightweight conductive gap filler. Validated 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 Materiel Command (AFMC) center infrastructure. 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. Evaluate domestic lithium ion precursor materials, active materials, associated testing, and battery-cell manufacturing for acceleration of industrial development.	3.442	3.335	3.140	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems			PROJECT NUMBER 633946	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Refine processes for producing large area, high-quality diamond windows for airborne high power microwave directed energy weapons. Initially develop nanostructured materials using multiple approaches for high energy density capacitors for pulsed power applications. Transition and validate the methodology to characterize LO materials during production for process control and process validation.					
MAJOR THRUST: 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: Increase in FY 2010 is due to increased emphasis in composites technology. In FY 2008: Identified and prioritized critical issues that are preventing transition of emerging materials and processes for sustainment of Air Force systems. In FY 2009: Develop test methodologies and evaluation techniques to facilitate transition of emerging materials and processes for sustainment of Air Force systems. In FY 2010: Demonstrate innovative technologies for bare base utilities. Develop new design and manufacturing processes to achieve dramatic reductions in nonrecurring fabrication and assembly tooling costs and schedules for composite and metallic aircraft utilizing bonded structures and friction stir welding.		0.218	1.112	4.442	
MAJOR THRUST: Develop and demonstrate practical, affordable, and novel high temperature materials, structures, and thermal management concepts to enable future defense capabilities for prompt global strike concepts including advanced hypersonic weapon, high mach missiles, global strike missiles, hypervelocity flight vehicles and propulsion systems, and hypervelocity weapons. Note: The breakout of funding in FY 2010 and out is a result of increased emphasis in high temperature materials. In FY 2008: Not Applicable.		0.000	0.000	2.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems			PROJECT NUMBER 633946	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Not Applicable. In FY 2010: Identify key issues and structural concepts for hot structure and thermal protection systems to be fabricated from advanced ceramics, ceramic matrix composites, hybrids, and advanced metals and intermetallics.					
CONGRESSIONAL ADD: Metals Affordability Initiative. In FY 2008: Conducted Congressionally-directed effort for Metals Affordability Initiative. In FY 2009: Conduct Congressionally-directed effort for Metals Affordability Initiative. In FY 2010: Not Applicable.		4.856	3.989	0.000	
CONGRESSIONAL ADD: Coated Field Repair (2K Gun). In FY 2008: Conducted Congressionally-directed effort for Coated Field Repair (2K Gun). In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.971	0.000	0.000	
CONGRESSIONAL ADD: EMI Grid Fabrication Technology. In FY 2008: Conducted Congressionally-directed effort for EMI Grid Fabrication Technology.		1.553	2.713	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER 633946

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Conduct Congressionally-directed effort for EMI Grid Fabrication Technology. In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: Silicon Carbide Electronics Material Producibility Initiative. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Silicon Carbide Electronics Material Producibility Initiative. In FY 2010: Not Applicable.	0.000	4.787	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER 633946

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0603203F/ Advanced Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603211F/ Aerospace Technology Dev/Demo.	0.000	0.000							Continuing	Continuing
PE 0603216F/ Aerospace Propulsion and Power Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems					PROJECT NUMBER 634918	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
634918: Deployed Air Base Demonstrations	13.760	11.287	2.386						Continuing	Continuing

Note

Note: FY 2008 funding totals include $5.437 million in supplemental funding.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Demonstrate and transition advanced deployable airbase technologies, including energy and aircraft operating surfaces, to reduce airlift and manpower requirements, setup times, and sustainment costs in support of AEF operations, while providing independence from host nation energy, utilities, and infrastructure. Note: In FY 2009, this effort increases emphasis on airfield damage repair technologies. In FY 2008: Developed transition plan and specifications for system development and demonstration. Characterized catalytic and surface chemistry technologies for application to bare base utilities. Developed and demonstrated continuous load deflection technologies and improved crater/spall repair. 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 airfield damage repair and matting technologies that address field critical conditions, represented by key performance parameters, including issues like reduced weight and ease of installation and repair in the field. In FY 2010: Demonstrate and transition methods for integrated, advanced power generation and distribution. Demonstrate methods and technologies for performing aircraft operating surface evaluations for ability to	1.729	4.379	1.157	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems			PROJECT NUMBER 634918	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
sustain aircraft operations. Demonstrate and analyze rapid temporary and permanent high temperature operating surface repairs.					
MAJOR THRUST: Demonstrate and transition affordable, efficient technologies to provide force protection and fire fighting capability for deployed AEF operations. In FY 2008: Developed and analyzed effectiveness of improved blast suppression technologies and fragmentation protection materials for new and existing structures. Demonstrated explosives detection technologies. Transitioned technical orders and construction standards supporting fire suppression technologies for fire fighter safety technologies. Evaluated ultrahigh pressure, standoff nozzles, and other innovative technologies with test bed vehicles. Developed air filtration and model/evaluate reactive filtration effectiveness for expeditionary structures. 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. In FY 2010: Demonstrate agile and lightweight adaptive blast suppression materials in representative structures. Integrate and demonstrate candidate fire fighter safety technologies against representative environments and threats. Integrate and demonstrate candidate ultrahigh pressure, nozzles, and other technologies in fire safety systems. Demonstrate air filtration and reactive filtration effectiveness for expeditionary structures and personnel protection.		2.517	1.523	1.229	
CONGRESSIONAL ADD: Body Armor Improved Ballistic Protection.		1.553	1.995	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems			PROJECT NUMBER 634918	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Conducted Congressionally-directed effort for Body Armor Improved Ballistic Protection. In FY 2009: Conduct Congressionally-directed effort for Body Armor Improved Ballistic Protection. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Encapsulated Ballistic Protection System (EBPS). In FY 2008: Conducted Congressionally-directed effort for EBPS. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.971	0.000	0.000	
CONGRESSIONAL ADD: Strategic Biofuel Supply Program. In FY 2008: Conducted Congressionally-directed effort for Strategic Bio-fuels Supply Program. In FY 2009: Conduct Congressionally-directed effort for Strategic Biofuel Supply Program. In FY 2010: Not Applicable.		1.553	0.997	0.000	
MAJOR THRUST: Airfield Damage Repair (ADR). In FY 2008 GWOT: Developed technologies to maintain and repair CENTAF runways to support increased aircraft traffic and heavy loads. Technologies included pelletization repair of asphalt pavements; advanced		2.580	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems			PROJECT NUMBER 634918	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
spall repair methods, equipment testing, and certification; asphalt material field tests; and automated ADR assessment tool development. These efforts minimized runway repair time and airfield downtime. Delivered to our deployed civil engineer warfighters (1) advanced/aircraft-certified pavement repair materials (rapid-set); more durable/effective in hot/austere environments; and (2) improved tactics, techniques, and procedures for repairing Soviet-designed airfields. In FY 2009: Not Applicable. In FY 2010: Not Applicable.					
MAJOR THRUST: Counter-Improvised Explosive Device (C-IED) - Sniper-Protected Robotics Operation. In FY 2008 GWOT: Developed sniper-protected capability to transport, employ, control, and recover explosive ordnance disposal (EOD) robots, which allowed EOD forces to deploy and operate C-IED equipment form the safety of their armored response vehicles. Current dismounted operations consistently expose EOD personnel to enemy sniper fire and related threats. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		2.857	0.000	0.000	
CONGRESSIONAL ADD: Sewage-Derived Biofuels Project. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Sewage-Derived Biofuels Project. In FY 2010: Not Applicable.		0.000	2.393	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER 634918

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0603287F/ Physical Security Equipment.	0.000	0.000							Continuing	Continuing
PE 0604617F/ Agile Combat Support.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems					PROJECT NUMBER 6377SP	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
6377SP: Advanced Space Materials	5.822	3.203	0.000						Continuing	Continuing

Note

Note: Funds from Project 77SP have been moved to Project 2100 within this Program Element to more accurately align efforts.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Refined developed materials formulations and approaches for thermal protection systems and aeroshells that provide solutions for cost-effective scale-up, fabrication, and integration techniques. Validated 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. In FY 2009: Utilizing newly developed materials approaches, fabricate thermal protection system sub-components for high temperature testing. Develop a sub-component cryogenic tank article and demonstrate the integration of ceramic, metallic, and carbon-carbon thermal protection system components. In FY 2010: Not Applicable.	2.691	1.496	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER 6377SP

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and demonstrate advanced materials technologies that enhance hardening for space systems. In FY 2008: Optimized and validated limiter and filter technology for protection against low and high power lasers. Analyzed laser phenomenology for intrinsic hardening solutions to jamming and damage susceptibility in electro-optical sensors. 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. In FY 2010: Not Applicable.	3.131	1.707	0.000	

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/Not Applicable.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603199F Sustainment Science and Technology (S&T)					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	0.000	2.955						Continuing	Continuing
635351: Technology Sustainment	0.000	0.000	2.955						Continuing	Continuing

Note

Note: This program represents increased emphasis on sustainment technologies previously addressed within the individual S&T programs and is not a new start.

A. Mission Description and Budget Item Justification

This program develops and demonstrates sustainment technologies for transition into Air Force systems to increase readiness and reduce life cycle costs. Technologies matured and demonstrated in this program impact affordability and availability of fielded and future aerospace weapon systems by extending service life, ensuring flight safety, reducing sustainment costs, and ensuring mission readiness and capability. This program develops and demonstrates technologies that can be implemented to address operational sustainment issues on existing systems as well as supports new system sustainability through demonstration of technologies related to robust life cycle management, system design, fleet management decision making, and mission capability. Studies are conducted to identify and analyze design methodologies that focus on "building" in sustainability into future applications.

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for sustainment of existing and future aerospace vehicle system upgrades and/or new system developments that have military utility and address warfighter needs.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603199F Sustainment Science and Technology (S&T)

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	0.000	0.000	0.000	
Current BES/President's Budget	0.000	0.000	2.955	
Total Adjustments	0.000	0.000	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	0.000		
Total Congressional Increases	0.000	0.000		
Total Reprogrammings	0.000	0.000		
SBIR/STTR Transfer	0.000	0.000		

Change Summary Explanation

This program represents increased emphasis on sustainment technologies previously addressed within the individual S&T programs and is not a new start.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603199F Sustainment Science and Technology (S&T)					PROJECT NUMBER 635351	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635351: Technology Sustainment	0.000	0.000	2.955						Continuing	Continuing

Note

Note: This program represents increased emphasis on sustainment technologies previously addressed within the individual S&T programs and is not a new start.

A. Mission Description and Budget Item Justification

N/A

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop, demonstrate, and transition system health prediction technologies to guide field and depot level maintenance action requirements, providing the capability to improve state awareness, diagnostics, prediction of failure and remaining useful life at the component and system level, and determine system current and future health status and mission capability, increasing readiness and reducing life cycle costs. Conduct studies and analyses to "design" in sustainability into future applications In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop and demonstrate fatigue/corrosion diagnostics sensors and algorithms for interpreting sensor data. Verify capability of state of the art reasoners to assess component health. Verify and validate real time material state awareness capability for turbine engine and airframe structural components. Demonstrate real time diagnostic technologies and develop life prediction model capability to support risk based decision making and prognostics. Incorporate health assessment technologies into system data environment.	0.000	0.000	1.485	
	0.000	0.000	0.490	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603199F Sustainment Science and Technology (S&T)	PROJECT NUMBER 635351

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop, demonstrate, and transition technologies to improve component design, maintenance, replacement, and analytical certification concepts for life enhancement, performance improvement, and reduced maintenance, inspection, and replacement burden. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Evaluate low maintenance materials and structural concepts. Integrate structural life enhancement/replacement application concepts. Demonstrate risk based approach to structural integrity decision making. Demonstrate capability of certification by analysis to reduce design time, implementation, and sustainment costs. Develop technology options to improve sustainability of systems via material substitution, process modification, nondestructive inspection tools, and risk based modeling and decision making to ensure full system operability, sustainability, and safety.				
MAJOR THRUST: Develop, demonstrate, and transition technologies to improve maintenance, supply, and repair requirements/procedures on existing and new components to decrease system downtime and maintenance costs, and increase reliability, availability, service life, and mission capability. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop and demonstrate technologies that directly respond to sustainment needs identified by existing AF systems. Evaluate methods to adjust maintenance, supply, and repair workflow procedures and requirements to improve system availability and reduce the cost of system management and operational sustainment. Demonstrate high reliability maintenance free repair technologies. Demonstrate improved maintenance and repair data base systems. Demonstrate technology solutions for future and existing system maintenance issues.	0.000	0.000	0.980	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603199F Sustainment Science and Technology (S&T)	PROJECT NUMBER 635351

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/PE 0602201F Aerospace Vehicle Technologies	0.000	0.000							Continuing	Continuing
Activity Not Provided/PE 0603211F Aerospace Technology Dev/Demo	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603203F Advanced Aerospace Sensors					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	60.877	65.115	51.482						Continuing	Continuing
63665A: Advanced Aerospace Sensors Technology	17.313	20.080	27.329						Continuing	Continuing
6369DF: Target Attack and Recognition Technology	31.317	34.823	24.153						Continuing	Continuing
6388SP: Advanced Space Sensors	12.247	10.212	0.000						Continuing	Continuing

Note

Note: Funds for the FY 2008 Congressionally-directed Moving Target Strike in the amount of $1.6 million are in the process of being moved from PE 0603203F, Advanced Aerospace Sensors, to PE 0603601F, Conventional Weapons Technology, for execution.

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 sensors, radar sensors and electronic counter-countermeasures, and components and algorithms. The second project develops and demonstrates radio frequency and electro-optical 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 radio-frequency sensors; intelligence, surveillance, and reconnaissance sensors; electro-optical sensors; laser warning sensors; targeting and attack radar sensors; and electronic counter-countermeasures 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. 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, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603203F Advanced Aerospace Sensors

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	62.332	56.916	58.664	
Current BES/President's Budget	60.877	65.115	51.482	
Total Adjustments	-1.455	8.199	0.000	
Congressional Program Reductions	0.000	1.177		
Congressional Rescissions	0.000	-0.178		
Total Congressional Increases	0.000	7.200		
Total Reprogrammings	0.000	0.000		
SBIR/STTR Transfer	-1.455	0.000		

Change Summary Explanation

Note: In FY 2009, Congress added +$2.0M for Unmanned Air Vehicle Phenomenology and Automatic Target Recognition Tech Transition, +$1.6M for Automated Sensor-Communication Response Technology, +$2.0M for Moving Target Strike, +$1.6M for Precision Image Tracking and Registration, and +$1.2M for Reconfigurable Secure Computing Technologies.

C. Performance Metrics

Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603203F Advanced Aerospace Sensors					PROJECT NUMBER 63665A	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
63665A: Advanced Aerospace Sensors Technology	17.313	20.080	27.329						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates aerospace sensor and processing technologies for intelligence, surveillance, reconnaissance, target, and attack radar applications in both manned and unmanned platforms, including electro-optical 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 radio-frequency systems including radar and electronic warfare technology. Desired warfighting capabilities include the ability to detect concealed targets in difficult background conditions.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop integrated electro-optical sensor technologies 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. Note: Funding peaks in FY 2008 due to the final increment of funding to develop the three-dimensional laser detection and ranging system supporting automated/assisted target recognition of obscured and urban targets, and the start of the system engineering and integration phase of that effort. In FY 2008: Began airborne experiments demonstrating multi-function active/passive electro-optical/infrared demonstration system to detect, locate, and identify difficult targets in both obscured and urban environments for intelligence, surveillance, and reconnaissance applications. Performed fabrication and testing of high-resolution, three-dimensional laser radar 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. Performed concept demonstration of multispectral/polarimetric focal plane array device for enhanced low contrast target discrimination. Completed fabrication of improved three-dimensional laser detection and ranging system and conducted testing of the engineering model.	6.502	4.259	4.002	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification			DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603203F Advanced Aerospace Sensors			PROJECT NUMBER 63665A	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Continue airborne experiments with a multi-function active/passive electro-optical/infrared demonstration system to detect, locate, and identify difficult targets in both obscured and urban environments for intelligence, surveillance, and reconnaissance applications. Characterize end-to-end performance of high-resolution, three-dimensional laser radar 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. In FY 2010: Complete end-to-end performance characterization, via airborne flight test, of high-resolution, three-dimensional laser radar for high confidence target identification coupled with passive spectral imaging for low false alarm rate detection utilizing change detection and spatial-spectral discrimination techniques. Continue design of airborne multispectral/polarimetric sensor module for long range target discrimination and integrated laser radar for long range identification of stationary and moving targets.					
MAJOR THRUST: Develop technologies to maximize positional accuracy, timing accuracy, and exploitation techniques to improve offensive and defensive combat capabilities. In FY 2008: Developed worldwide ultra-accurate positioning system technologies to optimize time sensitive targeting, battlespace awareness, persistent intelligence, surveillance, and reconnaissance capabilities. Continued to develop multi-sensor phenomenology-based georegistration for imagery and perform lab tests of multi-intelligence georegistration. In FY 2009: Demonstrate worldwide ultra-accurate positioning system technologies to optimize time sensitive targeting, battlespace awareness, persistent intelligence, surveillance, and reconnaissance capabilities. Continue to develop multi-sensor phenomenology-based georegistration for imagery and perform lab tests of multi-intelligence georegistration.		2.217	1.819	0.704	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603203F Advanced Aerospace Sensors			PROJECT NUMBER 63665A	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Demonstrate optimized reference for precise emitter geolocation, utilizing advanced two-way time transfer techniques. Explore feasibility and goals for reference optimization for bi-static and multi-static radar application.					
MAJOR THRUST: Develop, test, evaluate, and demonstrate lightweight, low power, compact radio-frequency sensors to detect, track, and target high-value, time-critical targets that are difficult to detect through either stealth or concealment and enable persistent intelligence, surveillance, and reconnaissance from an unmanned aerial vehicle. Develop and validate long-range intelligence, surveillance, and reconnaissance 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 2010 is due to an increased focus on multi-intelligence radio-frequency systems. In FY 2008: Continued demonstration of the radio-frequency sensors of an integrated electro-optical/radio-frequency sensor suite (for unmanned aerial vehicles with severe size, weight, and power constraints) to enable single platform persistent intelligence, surveillance, and reconnaissance capabilities compatible with a system of systems architecture. Continued experiments with the modeling, simulation, and analysis test bed providing input into the required operation and controls for an airborne multi-intelligence experiment. Continued radar systems engineering support fostering the transition of developed enabling technologies and concepts to weapon systems and intelligence, surveillance, and reconnaissance assets. Initiated radar system analysis for improved air and ground target detection and tracking using cross-cued, dual-band radar. In FY 2009: Continue demonstration of the radio-frequency sensors of an integrated electro-optical/radio-frequency sensor suite for unmanned aerial vehicles with severe size, weight, and power constraints to enable single platform persistent intelligence, surveillance, and reconnaissance capabilities compatible with a system of systems architecture. Continue systems analysis for improved air and ground target detection and tracking using cross-cued, dual-band radar coupled with electronic support sensors. Enhance the modeling, simulation, and analysis test bed with the inclusion of electro-optical sensing modes, and provide input into the required design for an integrated electro-optical/radio-frequency sensor suite, including required data processing and		4.589	9.507	17.868	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603203F Advanced Aerospace Sensors			PROJECT NUMBER 63665A	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
exploitation. Continue sensor systems engineering support fostering the transition of developed enabling technologies and concepts to weapon systems and intelligence, surveillance, and reconnaissance assets. Continue experiments with the modeling, simulation, and analysis test bed providing input into a design for an airborne multi-intelligence experiment. In FY 2010: Continue demonstration of the radio-frequency sensors (Ultra-High Frequency (UHF) radar, X-band radar, electronic support sensors) of an integrated electro-optical/radio-frequency sensor suite for unmanned aerial vehicles with severe size, weight, and power constraints to enable persistent intelligence, surveillance, and reconnaissance capabilities compatible with a system of systems architecture. Utilize the modeling, simulation, and analysis test bed, including radio-frequency and electro-optical sensing modes, to provide input into the required design for an integrated electro-optical/radio-frequency 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 intelligence, surveillance, and reconnaissance assets. Enhance the systems engineering to consider the optimal use of a high-altitude, long-endurance sensor platform within a layered sensing architecture. Initiate effort using multi-intelligence sensor suite to improve detection and tracking of difficult targets such as dismounts or targets in urban areas. Initiate efforts to improve the capabilities of passive sensing to enhance the detection and tracking of airborne and ground based targets with low radar cross section (including dismounts), concealment capabilities, or employment of electronic counter-countermeasures.					
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. NOTE: Effort ends in FY 2009. In FY 2008: Demonstrated and evaluated multi-sensor waveform transmission and signal processing techniques on selected advanced computing architectures. Implemented novel space-time adaptive processing techniques that are robust to heterogeneous data. Implemented tactical sensor network operations on the developed advanced computer architectures used for algorithm/waveform analysis.		0.900	0.904	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER 63665A

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2010: Not Applicable.				
MAJOR THRUST: Develop and demonstrate technologies to provide precision position and timing information to enable distributed, layered sensing. Technologies include both Global Positioning Satellite (GPS) and non-GPS approaches, and must provide performance even in GPS-denied environments. Sensor size, weight, and power reduction will be pursued to allow installation on small as well as large air and space vehicles. Note: In FY 2010, this effort moved from Project 88SP to this project to better align efforts. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Design reduced size, weight, and power precision time, position, and velocity sensor techniques for space-based, airborne, and ground-based applications. Demonstrate constructive systems engineering model to assess assured reference techniques in terms of measures of performance and warfighter utility. Enhance multi-ship virtual flight test simulation technology to assess world-wide distributed position, navigation, and timing architectures for disparate platforms enabling distributed, layered sensing.	0.000	0.000	2.143	
MAJOR THRUST: Develop infrared surveillance technologies for battlespace awareness space-based platforms using high altitude airborne platforms as a pathfinder. Note: In FY 2010, this effort moved from Project 88SP to this project to better align efforts. In FY 2008: Not Applicable.	0.000	0.000	0.944	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603203F Advanced Aerospace Sensors			PROJECT NUMBER 63665A	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Not Applicable. In FY 2010: Initiate an effort to perform design studies and concept demonstration experiments for exploiting novel temporal, spectral, and polarimetric discrimination based on infrared sensors to rapidly detect, locate, identify, and characterize battlefield targets and events over broad theater-sized areas.					
MAJOR THRUST: Reduce technology risk for space sensor platform payload components and exploitation of infrastructure integration. Note: In FY 2010, this effort was moved from Project 88SP to this Project to better align efforts. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop Mission Design Tool kit and experimental hardware for class III (scalable payloads) sensors. Begin to address PnP (Plug and Play) concepts for large satellite systems.		0.000	0.000	1.668	
CONGRESSIONAL ADD: TACNODES. In FY 2008: Conducted Congressionally-directed effort for TACNODES. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		3.105	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER 63665A

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: Moving Target Strike. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Moving Target Strike. In FY 2010: Not Applicable.	0.000	1.995	0.000	
CONGRESSIONAL ADD: Precision Image Tracking and Registration. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Precision Image Tracking and Registration. In FY 2010: Not Applicable.	0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603205F/ Flight Vehicle Technology.	0.000	0.000							Continuing	Continuing
PE 0603707F/ Weather Systems Advanced Development.	0.000	0.000							Continuing	Continuing
PE 0603500F/ Multi-Disciplinary Advanced Development Space Technology.	0.000	0.000							Continuing	Continuing
PE 0602111N/ Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0602232N/ Space and Electronic Warfare (SEW) Technology.	0.000	0.000							Continuing	Continuing
PE 0604249F/ LANTIRN Night Precision Attack.	0.000	0.000							Continuing	Continuing
PE 0603270F/ Electronic Combat Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ A Memorandum of Agreement has been established between Air Force Research	0.000	0.000							Continuing	Continuing

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification			DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603203F Advanced Aerospace Sensors		PROJECT NUMBER 63665A

Laboratory and Defense Adv Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000	Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603203F Advanced Aerospace Sensors					PROJECT NUMBER 6369DF	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
6369DF: Target Attack and Recognition Technology	31.317	34.823	24.153						Continuing	Continuing

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. Note: Funding in Major Thrusts within this project decreases in FY 2008 and FY 2009 as (1) technology is transitioned to operational platforms; and (2) several Major Thrusts are created resulting from other work in the project for better management and oversight.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop and test an automatic target recognition system for tracking and identifying moving and stationary ground targets for use in strike and reconnaissance platforms. Note: The reduced emphasis in this thrust in FY 2009 is due to the transition of the technology to the warfighter. In FY 2008: Performed a real-time laboratory demonstration of a radar based air-to-ground moving target algorithm for tactical and reconnaissance platforms. Assessed performance against scenarios of interest to the warfighter as would be integrated into candidate radar systems. Provided support to the transition of the moving target algorithm technology to operational strike and reconnaissance platforms as necessary.	4.754	0.796	0.098	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Continue providing support to the transition of the moving target algorithm technology to operational strike and reconnaissance platforms. In FY 2010: Complete the transition of moving target algorithm technology to operational strike and reconnaissance platforms.					
MAJOR THRUST: Develop and assess multi-sensor automatic target recognition for intelligence, surveillance, reconnaissance, strike, and weapon systems. In FY 2008: Began spiral development and assessment of multi-sensor automatic target recognition fusion algorithms. Assessed technology supporting intelligence, surveillance, reconnaissance, strike, and weapon systems occurred in the Air Force automatic target recognition test and evaluation facility. Continued spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Critically examined target, scene, and scenario data to determine independence and interdependence of features to support development of an optimum data fusion exploitation capability. Enhanced the Air Force automatic target recognition test and evaluation facility and data sets as required to support enhanced automatic target recognition fusion capabilities. In FY 2009: Continue spiral development and assessment of multi-sensor automatic target recognition fusion algorithms. Continued assessment of technology supporting intelligence, surveillance, reconnaissance, strike, and weapon systems using the Air Force automatic target recognition test and evaluation facility. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Develop automatic target recognition 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 the Air Force automatic target recognition test and evaluation facility and data sets as required to support enhanced automatic target recognition fusion capabilities. Determine technology shortfalls and develop automatic target recognition fusion technologies to overcome these shortfalls.		3.800	2.089	1.961	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Continue spiral development and assessment of multi-sensor automatic target recognition fusion algorithms. Continued assessment of technology supporting intelligence, surveillance, reconnaissance, strike, and weapon systems using the Air Force automatic target recognition test and evaluation facility. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Continue development of an automatic target recognition 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 the Air Force automatic target recognition test and evaluation facility and data sets as required to support enhanced automatic target recognition fusion capabilities. Determine technology shortfalls and develop automatic target recognition fusion technologies to overcome these shortfalls. Execute a laboratory demonstration of technology developed to date.					
MAJOR THRUST: Develop and demonstrate a moderate-confidence automatic target recognition (ATR) and advanced cueing capability for stationary and moving targets. In FY 2008: Developed and evaluated 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. Developed and evaluated an initial design of a three-dimensional laser-detection-and-ranging automatic target recognition algorithm designed to achieve high confidence identification against targets in various degrees of clutter. Developed and evaluated an initial design of a laser vibrometry algorithm that provide the ability to determine target state (for example, engine on/off) and provide some level of counter denial and deception capability. Developed and evaluated an initial design of a sensor management suite that provides target cue prioritizations and look geometry optimization for three-dimensional laser-detection-and-ranging sensors. Developed and evaluated an initial set of exploitation tools that are optimized for use with three-dimensional laser-detection-and-ranging and laser vibrometry sensors. Enhanced automatic target recognition evaluation test facility and data sets as necessary to support program requirements.		7.871	6.722	2.794	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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 three-dimensional laser-detection-and-ranging automatic target recognition 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. Incorporate improvements in the initial set of laser sensor exploitation tools that were previously evaluated. Enhance automatic target recognition evaluation test facility and data sets as necessary to support program requirements. In FY 2010: Develop an electro-optic enhanced automatic target recognition system based on improvements provided by the multi-sensor fusion algorithms, the three-dimensional laser-detection-and-ranging automatic target recognition algorithms that were previously evaluated, the laser vibrometry algorithms and the sensor management suite that were previously evaluated. Enhance laser sensor exploitation tools as required to support spiral ATR development. Enhance automatic target recognition evaluation test facility and data sets as necessary to support program requirements.				
MAJOR THRUST: Develop and demonstrate an automatic target recognition capability integrated with advanced geo-registration techniques and innovative change detection algorithms. In FY 2008: Continued spiral assessment and development of automatic target recognition, automatic target cueing, geo-registration, and change-detection technology. Assessed technology supporting time-critical targeting systems in the Air Force automatic target recognition test and evaluation facility. Continued spiral development and validation of synthetic data generation capabilities critically needed to augment collected research, development, and operational data sets. Performed interim demonstration and evaluation of concealed target identification sensing and exploitation technologies. Performed interim demonstration and evaluation of advanced tracking and multi-sensor track maintenance technology in a militarily significant scenario. Enhanced the Air Force automatic target recognition test and evaluation facility and data sets as required to support time-critical targeting capabilities.	2.568	1.364	1.041	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Determine need to continue spiral assessment and development of automatic target recognition, automatic target cueing, geo-registration, and change detection technology. Continue assessment of technology supporting time-critical targeting systems in the Air Force automatic target recognition test and evaluation facility. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Demonstrate time-critical targeting, advanced target tracking and multi-sensor track maintenance capabilities. Enhance the Air Force automatic target recognition test and evaluation facility and data sets as required to support enhanced time-critical targeting capabilities. Determine technology shortfalls and develop emerging time-critical targeting and advanced target tracking technologies to overcome these shortfalls. In FY 2010: Assess performance of developed technology and develop enhancements to automatic target recognition, automatic target cueing, geo-registration, and change detection technology to meet warfighter needs. Continue assessment and enhancement of technology supporting time-critical targeting systems in the Air Force automatic target recognition test and evaluation facility. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Enhance the Air Force automatic target recognition test and evaluation facility and data sets as required to support enhanced time-critical targeting capabilities. Continue spiral development and assessment development of time-critical targeting and advanced target tracking technologies required to meet warfighter requirements.					
MAJOR THRUST: Develop an "identify friend, foe, or neutral" air-to-ground capability using cooperative and non-cooperative identification techniques. In FY 2008: Integrated and demonstrated improved ground target identification capabilities through enhanced target databases, identification algorithm advancements, and radio-frequency tags in a laboratory environment. Assessed maturity of technology via a combination of exercises and scientific analysis by the Air Force automatic target recognition evaluation test facility. Initiated spiral assessment and development of an "identify friend, foe, or neutral" air-to-ground capability, enhancing test facilities and target databases as necessary. Planned operational exercise support.		2.585	2.462	1.395	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Continue to integrate and demonstrate improved ground target identification capabilities through enhanced target databases, identification algorithm advancements, and radio-frequency tags in an operational environment. Assess performance of technology to support warfighter integration with operational systems. Continue refinement of identification algorithms and target databases as necessary to support transition of technology. In FY 2010: Integrate, demonstrate, and assess, in an operational environment, the improved ground target identification capabilities through enhanced target databases, identification algorithm advancements, and radio-frequency tags. Determine enhancements required to attain the required performance of these technologies to support warfighter needs. Continue refinement of identification algorithms, target databases, and exploitation tools as necessary to support transition of technology.					
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. In FY 2008: Designed and breadboarded the individual waveband sensors required to support the persistent staring and automated exploitation capability. Collected data required to support the development, testing, and validation of the automated exploitation of the wide angle, continuous staring capability. Assessed the maturity of the technology through scientific analyses conducted in the Air Force automatic target recognition test and evaluation facility. In FY 2009: Design and develop engineering models of the multi-sensor, multi-wavelength wide-angle, continuously-staring capability building upon the technologies developed during the individual component stage. Integrate and demonstrate the wide angle, continuously-staring component technologies. Assess the maturity of the technology via a combination of exercises and scientific analyses in the Air Force automatic target recognition test and evaluation facility. Initiate spiral development of wide angle, continuous staring		5.691	5.999	6.572	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
exploitation algorithms, phenomenological modeling, target and scenario databases necessary to support transition to the warfighter. Initiate Secretary of the Air Force Interest Item to develop electro-optical, infrared, and synthetic aperture radar staring-sensor technologies and algorithms. In FY 2010: Develop, integrate, and test the next spiral engineering model of the multi-sensor, multi-wavelength wide-angle, continuously-staring capability building upon the technologies developed during the individual component stage. Integrate, demonstrate, and test the enhanced, spiral two, wide angle, continuously-staring component technologies via a combination of exercises and scientific analyses in the Air Force automatic target recognition test and evaluation facility. Continue spiral development of wide angle, continuous staring exploitation algorithms, phenomenological modeling, target and scenario databases necessary to support transition to the warfighter. Demonstrate in a militarily significant scenario, evaluate results and plan for transition.					
MAJOR THRUST: Develop an advanced suite of sensors with automatic target recognition, fusion, and target tracking, all working in concert to provide a high-confidence identification capability. Note: This work is an outgrowth of other work within this project. In FY 2008: Initiated spiral development of high confidence identification algorithm for phenomenological modeling, and target and scenario databases necessary to support technology development. In FY 2009: Design and test an advanced aimpoint tracking capability. Develop and test automatic target recognition capability using electro-optical sensor data. Build upon previous synthetic aperture radar automatic target recognition capability to develop a high confidence exploitation of synthetic aperture radar data. Develop an advanced capability to fuse information and exploitation results from multiple sensors. Continue spiral high confidence identification 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 automatic target recognition test and evaluation facility and other sensor test facilities.		0.167	10.603	9.909	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Integrate the advanced aimpoint tracking, electro-optical automatic target recognition, synthetic aperture radar automatic target recognition and the multi-sensor fusion algorithms. Test the integrated system and develop the second spiral requirements. Enhance phenomenological modeling, target and scenario databases and exploitation tools necessary to support spiral two technology development. Assess maturity of technology during the spiral process via the Air Force automatic target recognition test and evaluation facility and other sensor test facilities.				
MAJOR THRUST: Investigate the application of airborne target ID techniques and algorithms to space object identification and characterization. Airborne technology for multi-sensor data fusion for better characterization will be investigated. Note: In FY 2010, this effort moved from Project 88SP to this project to better align efforts. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Initiate an effort to process multiple sources of ground based space situational awareness (SSA) data on various space objects using upgraded space object ID algorithms for validation, along with upgrades to a space object ID database.	0.000	0.000	0.383	
CONGRESSIONAL ADD: Active Unmanned Air Vehicle (UAV) Phenomenology (AUP) & ART Technology Transition. In FY 2008: Conducted Congressionally-directed effort for Active Unmanned Air Vehicle (UAV) Phenomenology (AUP) & ART Technology Transition. In FY 2009: Conduct Congressionally-directed effort for Active Unmanned Air Vehicle (UAV) Phenomenology (AUP) & ART Technology Transition.	3.881	1.995	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: Automated Sensor-Communication Response Technology. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Automated Sensor-Communication Response Technology. In FY 2010: Not Applicable.	0.000	1.596	0.000	
CONGRESSIONAL ADD: Reconfigurable Secure Computing Technologies. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Reconfigurable Secure Computing Technologies. In FY 2010: Not Applicable.	0.000	1.197	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603253F/ Advanced Sensor Integration.	0.000	0.000							Continuing	Continuing
PE 0603500F/ Multi-Disciplinary Advanced Space Technology.	0.000	0.000							Continuing	Continuing
PE 0603762E/ Sensor and Guidance Technology.	0.000	0.000							Continuing	Continuing
PE 0603270F/ Electronic Combat Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ Theater Missile Defense System Program Office.	0.000	0.000							Continuing	Continuing
Activity Not Provided/Low Altitude Night Targeting and Infrared Navigation (LANTIRN) System Program Office.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
6388SP: Advanced Space Sensors	12.247	10.212	0.000						Continuing	Continuing

Note

Note: In FY 2010, funds from Project 88SP are being moved to Projects 665A and 69DF to better align efforts.

A. Mission Description and Budget Item Justification

This project develops and demonstrates space sensor technologies, including radio frequency sensors; intelligence, surveillance, and reconnaissance sensors; electro-optical sensors; laser warning sensors; targeting and attack radar sensors; and electronic counter-countermeasures and communications. By developing multi-function radar, laser, electronic combat, and electronic counter-countermeasures 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Reduce technology risk for space sensor platform payload components and exploitation of infrastructure integration. In FY 2008: Developed approach to design responsive space payload capabilities while retaining hardware implementation feasibility. Defined payload to bus satellite interface requirements and standards. In FY 2009: Develop "plug-and-play" satellite critical experiment, to including full simulation. In FY 2010: Not Applicable.	0.457	0.835	0.000	
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.	1.289	2.186	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603203F Advanced Aerospace Sensors			PROJECT NUMBER 6388SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Designed space-based distributed position, navigation, and timing technologies to detect, identify, and locate global positioning system threats. Designed multi-ship virtual flight test simulation technology to assess networked clusters of unmanned aerial vehicles, intelligence, surveillance, and reconnaissance platforms, and space-based platforms. In FY 2009: Demonstrate space-based distributed position, navigation, and timing technologies to achieve optimal sensor fusion for distributed, layered sensing. Demonstrate multi-ship virtual flight test simulation technology to assess world-wide distributed position, navigation, and timing architectures for disparate platforms across distributed, layered sensing. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop electro-optical sensor component technology to advance multiple space mission areas. Develop new sensor components, topologies and architectures for space. In FY 2008: Conducted experimental space flight of sensor components to test in space environment. Initiated data collection, testing, and system evaluation with relevant space environment phenomenology. 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. In FY 2010: Not Applicable.		1.615	1.512	0.000	
MAJOR THRUST: Develop advanced laser communication component and sub-system technology to support a network-level topology for airborne intelligence, surveillance, and reconnaissance.		6.349	5.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603203F Advanced Aerospace Sensors			PROJECT NUMBER 6388SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Continued development of an integrated wideband radio-frequency/electro-optical communication terminal and shared aperture antenna. Began evaluation and testing of the integrated terminal and antenna in an air network layer. Began maturation of technologies for integration into airborne network communication architecture. Continued flight demonstrations of optical communication terminal technologies for air-network layers. In FY 2009: Continue maturation of technologies for integration into airborne network communication architecture. Conduct further ground and flight tests of laser communication system. Continue development of advanced Free Space Optical Modem focusing on compact packaging for Airborne Terminal Rack (ATR) rack installations. Integrate Optical terminal with RF communications gear to enable testing of hybrid free space optical and radio-frequency communications terminal for Intelligence Surveillance and Reconnaissance (ISR) relay missions. Demonstrate hybrid free space optical/radio frequency failsafe/failback operations in airborne tests. This effort ends in FY 2009. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop and demonstrate a geodesic phased array antenna to achieve enhanced satellite operations over current reflector antennas. Improve operational capacity and efficiency to support satellite control network. In FY 2008: Fabricated transmit/receive modules, radiating elements, beam former array panels for the geodesic phased array antenna dome sub-sector to be used in the advanced technology demonstration. In FY 2009: Fully characterize the advanced technology demonstrator sub-sector and demonstrate with operational satellites. This effort is complete in FY 2009. In FY 2010: Not Applicable.		2.537	0.679	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER 6388SP

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0602500F/ Multi-Disciplinary Space Technology.	0.000	0.000							Continuing	Continuing
PE 0603500F/ Multi-Disciplinary Advanced Development Space Technology.	0.000	0.000							Continuing	Continuing
PE 0603270F/ Electronic Combat Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603211F Aerospace Technology Dev/Demo					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	70.352	45.990	76.844						Continuing	Continuing
63486U: Advanced Aerospace Structures	2.320	1.197	0.000						Continuing	Continuing
634920: Flight Vehicle Tech Integration	68.032	44.793	76.844						Continuing	Continuing

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. Aerospace vehicle technology integration is accomplished through integration of various technologies to include avionics, advanced propulsion, and weapons systems for demonstration in near-realistic operational environments.

This program is in 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.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	66.884	44.918	83.204	
Current BES/President's Budget	70.352	45.990	76.844	
Total Adjustments	3.468	1.072	0.000	
Congressional Program Reductions	0.000	-0.003		
Congressional Rescissions	0.000	-0.125		
Total Congressional Increases	0.000	1.200		
Total Reprogrammings	5.252	0.000		
SBIR/STTR Transfer	-1.784	0.000		

Change Summary Explanation

Note 1: In FY 2008, $0.276 million was added for the Global War on Terrorism and this funding is being re-programmed to PE 0603231F - Crew Systems and Personnel Protection Technology for execution. Note 2: In FY 2009, Congress added $1.2 million for Big Antennas Small Structures Efficient Tactical (BASSET) unmanned air vehicle.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603211F Aerospace Technology Dev/Demo

(U) C. Performance Metrics
Under Development

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603211F Aerospace Technology Dev/Demo					PROJECT NUMBER 63486U	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
63486U: Advanced Aerospace Structures	2.320	1.197	0.000						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: Advanced Aerospace Titanium Structures (AATS) Initiative. In FY 2008: Conducted Congressionally-directed AATS effort. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	1.546	0.000	0.000	
CONGRESSIONAL ADD: Big Antennas Small Structures Efficient Tactical (BASSET) Unmanned Airl Vehicles. In FY 2008: Conducted Congressionally-directed effort for big antennas small structures efficient tactical unmanned air vehicles. In FY 2009: Conduct Congressionally-directed effort for big antennas small structures efficient tactical unmanned air vehicles.	0.774	1.197	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603211F Aerospace Technology Dev/Demo	PROJECT NUMBER 63486U

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Not Applicable.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603211F Aerospace Technology Dev/Demo					PROJECT NUMBER 634920	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
634920: Flight Vehicle Tech Integration	68.032	44.793	76.844						Continuing	Continuing

Note

Note: In FY 2008, $0.276 million was added for the Global War on Terrorism. This funding is being re-programed to PE 0603231F - Crew Systems and Personnel Protection Technology for execution. Increased funding in FY 2010 is due to FY 2008 emphasis being placed on flight demonstration efforts of an X-type composite cargo aircraft.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop autonomous flight controls for safe flight and cooperative operations between manned and unmanned air platforms. Note: Increased funding FY 2010 is due to increased emphasis being placed on improving the control of unmanned platforms. In FY 2008: Further developed situational awareness and control technologies for automated air base ground operations for unmanned air vehicles. Initiated electromagnetic threat tolerant control systems technologies for air base ground operations for unmanned air vehicles. In FY 2009: Conduct ground demonstrations of situational awareness and control technologies for unmanned air vehicles operating in and around air bases. 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.	6.299	6.485	8.573	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603211F Aerospace Technology Dev/Demo	PROJECT NUMBER 634920

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Further the development and demonstration of situational awareness, autonomous control, and survivability technologies for manned and unmanned air vehicles. Continue development and demonstration of cooperative teaming of small unmanned air vehicles in complex, low altitude environments. Continue development of autonomous launch, recovery, and safe airspace interoperability technologies for unmanned systems. Extend adaptive guidance, navigation, and control technology for use in reusable launch systems.				
MAJOR THRUST/CONGRESSIONAL ADD: Develop, simulate, and demonstrate integrated technologies to improve the performance of manned and unmanned platforms. Note: In FY 2008, fabrication of X-type cargo aircraft was completed. Increased funding in FY 2010 is due to increased emphasis being placed on flight demonstration efforts of an X-type cargo aircraft. In FY 2008: Conducted flight demonstration of extensive laminar flow on swept wing test article. Completed wind tunnel testing of gust load alleviation and body freedom flutter suppression of high altitude, long endurance platforms. Completed 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. Developed and integrated aircraft components that capitalize upon unitized advanced materials that are lightweight and affordable into an X-type cargo aircraft. Developed approaches that would reduce the tooling required to fabricate aircraft components. Began flight demonstration efforts for an X-type cargo aircraft. 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. Continue development of a simulation environment to enable evaluation of network centric technologies for improved capabilities for high speed operational concepts. In FY 2010: Continue work to develop and demonstrate flow control for reducing acoustic loading and enhancing weapon separation from future strike platforms. Continue development of a simulation environment	44.405	17.014	32.308	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603211F Aerospace Technology Dev/Demo			PROJECT NUMBER 634920	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
to enable evaluation of network centric technologies for improved capabilities for high speed operational concepts. Conduct flight demonstration efforts of an X-type cargo aircraft with all composite wings.					
MAJOR THRUST: Develop aircraft structures that have embedded components, which have previously been separate components that were attached to the air platforms. Note: Increased funding in FY 2010 is due to increased emphasis being placed on demonstration efforts related to integrated airframe components. In FY 2008: Conducted structural demonstration of low band antenna structure. Assessed and refined development of multi-functional integrated structures to reduce cost, and weight, while improving performance of future air platforms. Completed fabrication and flight test a large X-band electronically-scanned antenna array embedded in a load-bearing structure. 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. In FY 2010: Complete assessment of test results from the flight demonstration of the large X-band electronically scanned antenna array embedded in a load-bearing structure. Demonstrate and assess results of ultra lightweight multi-functional airframes. Demonstrate key high altitude persistent Intelligence, Surveillance, and Reconnaissance technologies.		14.003	13.160	15.467	
MAJOR THRUST: Develop adaptive structures to provide in-flight modifications offering improved performance over a wide range of flight conditions and mission profiles. Note: Increased funding in FY 2010 is due to increased emphasis being placed on demonstration efforts related to integrated airframe components for high speed vehicle applications. In FY 2008: Developed passive and active leading edge cooling systems for ultra, high-speed vehicles. Developed and validated integration methodologies for component level leading edge test articles. Completed		3.325	8.134	16.264	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603211F Aerospace Technology Dev/Demo			PROJECT NUMBER 634920	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
development and demonstration of highly efficient wing concepts integrating active aero elastic design concepts. In FY 2009: Demonstrate passive and active thermal protection systems for leading edge of high-speed vehicle components. Assess results from demonstrations of advanced efficient wings concepts integrating active aeroelastic design concepts and adaptive structures. In FY 2010: Demonstrate passive and active thermal protection systems for leading edge of high-speed vehicle components. Continue assessment of results from demonstrations of advanced efficient wings concepts integrating active aeroelastic design concepts and adaptive structures. Demonstrate and assess rapid operability, maintainability, and support capabilities of conceptual reusable hypersonic vehicles. Demonstrate and assess integrated structural health management for load bearing composite tanks and wing structures. Demonstrate the characterization of high energy laser concepts for flight class, weight, and performance.					
MAJOR THRUST: Develop, simulate, and demonstrate integrated aeromechanics, structures and controls technologies to enable, and improve the performance of high-speed and hypersonic manned and unmanned air vehicles. Note: In FY 2010 increased emphasis is being placed on technology development/demonstration efforts relevant to unpowered hypersonic boost-glide vehicles. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Initiate work to develop and demonstrate hypersonic ablation /shape-change measurement and prediction capabilities for carbon/carbon materials and low-temperature material analogues and apply these methods to understand shape change for upcoming high-speed tests and other current prompt global reach concepts under development. Initiate risk reduction research in the areas of aeromechanics, propulsion integration, controls, and hot structures for the high-speed combined-cycle propulsion demonstration program.		0.000	0.000	4.232	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603211F Aerospace Technology Dev/Demo	PROJECT NUMBER 634920

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602201F/ Aerospace Vehicle Technologies.	0.000	0.000							Continuing	Continuing
PE 0604015F/ Next Generation Bomber.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	139.591	180.554	175.676						Continuing	Continuing
6310SP: Space Rocket Prop Demo	32.871	24.265	0.000						Continuing	Continuing
632480: Aerospace Fuels	8.469	17.339	12.019						Continuing	Continuing
633035: Aerospace Power Technology	13.945	12.030	9.401						Continuing	Continuing
634921: Aircraft Propulsion Subsystems Int	25.870	47.451	36.568						Continuing	Continuing
634922: Space & Missile Rocket Propulsion	4.525	5.068	29.648						Continuing	Continuing
635098: Advanced Aerospace Propulsion	20.917	22.921	23.940						Continuing	Continuing
63681B: Advanced Turbine Engine Gas Generator	32.994	51.480	64.100						Continuing	Continuing

Note

Note: 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.

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 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 as part of the Integrated Vehicle Energy Technology (INVENT) program. 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 (VAATE) 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, manufacturing techniques. Rocket propulsion projects within this program are part of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program, which includes the area of Technology for the Sustainment of Strategic Systems. In FY08 the Space and Rocket Propulsion Demonstration project develops and demonstrates advanced and innovative low cost rocket turbo machinery and components, low cost space launch propulsion system technologies, and advanced propellants for launch and orbit transfer propulsion. In FY10 work in 10SP will be consolidated into 4922 to better align work.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	142.543	170.856	189.246	
Current BES/President's Budget	139.591	180.554	175.676	
Total Adjustments	-2.952	9.698	0.000	
Congressional Program Reductions	0.000	-5.011		
Congressional Rescissions	0.000	-0.491		
Total Congressional Increases	0.000	14.400		
Total Reprogrammings	0.573	0.800		
SBIR/STTR Transfer	-3.525	0.000		

Change Summary Explanation

In FY 2009 Congress added $0.8 million for Hybrid Sounding Rocket Propulsion; $1.6 million for the Texas Research Institute for Environmental Studies; $1.6 million for Assured Aerospace Fuels Research; $0.8 million for Bio-JP8 Fuels Research; $2.0 million for Renewable Hydrocarbon Fuels for Military Applications (Great Lake Region); $3.2 million for Silicon Carbide (SiC) Power Electronics for More Electric Aircraft; $3.6 million for Versatile Affordable Advance Turbine Engine (VAATE) - Small Turbofan (STF);and, $1.6 million for Small Adaptive Cycle 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 war-fighter needs. In FY09 and beyond, funds from Project 10SP have been moved to Project 4922 within this Program Element to more accurately align efforts.

C. Performance Metrics

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology

(U) Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology					PROJECT NUMBER 6310SP	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
6310SP: Space Rocket Prop Demo	32.871	24.265	0.000						Continuing	Continuing

Note

Note: In FY10 and beyond, this work was moved to Project 4922 within this Program Element to better align efforts.

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced and innovative low-cost rocket turbo-machinery 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. In FY10 and beyond, this work was moved to Project 4922 within this Program Element to better align efforts.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch vehicles. Note: In FY 2009 a portion of the funding was moved to support higher Air Force priorities. In FY 2008: Began hardware fabrication for advanced cryogenic upper stage technologies - turbopumps and thrust chambers. These components were used to validate modeling, simulation, and analysis tools being developed. Began preparations for testing of these components. Started component and engine designs for advanced hydrocarbon engine technologies for future reusable launch vehicles. Initiated an advanced manufacturing technology demo aimed at materials and processes to support the hydrocarbon engine	21.522	17.310	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 6310SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
technology development effort. Initiated an 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. 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. In FY 2010: Not Applicable.					
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. In FY 2008: Continued development of electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of Low Earth Orbit to Geosynchronous Orbit transfer. Continued component integration for the high-power Hall thruster demonstration. Continued hardware scale-up for an advanced multi-mode (high thrust or high efficiency) propulsion system for satellites. Completed development of satellite sensors to analyze satellite thruster interactions. In FY2009: Develop 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. In FY 2010: Not Applicable.		2.148	0.220	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 6310SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop electric and advanced chemical based monopropellant propulsion technologies for future satellite propulsion systems. Phases are referring to IHPRPT program phases. In FY 2008: Continued development of an advanced Phase III monopropellant thruster. In FY 2009: Continue development of advanced IHPRPT Phase III monopropellant thruster technologies. In FY 2010: Not applicable.		3.000	5.937	0.000	
CONGRESSIONAL ADD: Family of Motors Capability Demonstration. In FY 2008: Scaled-up & tested solid rocket motor component technologies to provide data on viability of a family of motors construct. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		6.201	0.000	0.000	
CONGRESSIONAL ADD: Hybrid Sounding Rocket Propulsion In FY 2008: Not Applicable. In FY 2009: Mature hybrid rocket propulsion technologies. In FY 2010: Not Applicable.		0.000	0.798	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER 6310SP

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/Not Applicable.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology					PROJECT NUMBER 632480	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
632480: Aerospace Fuels	8.469	17.339	12.019						Continuing	Continuing

Note

Note: The funding in this project has been increased in FY 2009 due to emphasis on component development in support of adaptive cycle technologies, alternative hydrocarbon jet fuel, and improved fuel efficiency.

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 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 (VAATE) 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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 adaptive cycle engine architecture. 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: Funding shift caused delay in development of this effort. Increased funding in FY 2009 and out due to emphasis on component development in support of adaptive cycle technologies. In FY 2008: Demonstrated fuel combustion performance at fuel temperatures in the supercritical regime, as might be encountered in an engine employing a cooled cooling air system. Demonstrated engine durability benefits from the use of alternative fuels. Developed relationship between alternate fuel composition and	1.032	2.000	3.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology		PROJECT NUMBER 632480	
B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
key properties, including low temperature viscosity and thermal/storage stability. Improved physical property models for alternative fuels. Developed relationship between fuel/material interactions and fuel (and material) structure. In FY 2009: Demonstrate engine and airframe durability and performance benefits from the use of alternative fuels. Develop knowledge base needed for Air Force-wide certification of alternative fuels, especially biofuels. Demonstrate 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. In FY 2010: Develop and asses an advanced ADVENT/HEETE integrated power/thermal management systems that include cooled cooling air systems, as well as approaches to deoxygenate fuel to improve thermal stability.				
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 2010 efforts in this and the next major thrust were combined to more accurately align efforts with organizational structure. In FY 2008: Demonstrated advanced low temperature and enhanced performance fuels for UAV applications and the Highly Efficient Embedded Turbine Engine (HEETE), focusing on advanced thermal management technologies that expand the flight envelope, range, or duration of UAVs. 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.	1.874	2.354	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 632480	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
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. In FY 2008: Demonstrated advanced particulate measurement diagnostics suitable for full-scale engine testing. Initiated demonstration of fuel/combustor concepts that reduce both soot and NOx. 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. In FY 2010: Assess fuel structure/combustion performance relationship in high pressure combustor. Demonstrate advanced particulate measurement diagnostics suitable for full-scale engine testing. Assess effectiveness of chemical kinetic models for jet fuels to match high pressure combustor flame data.		0.500	1.000	1.500	
MAJOR THRUST: Develop and demonstrate enhancements to fuel system technology. In FY 2008: Developed and demonstrated combined cycle engine cooling systems and technologies utilizing 2nd generation endothermic fuels and other advanced fuels. In FY 2009: Develop combined cycle engine cooling systems, utilizing 2nd-generation endothermic fuels and other advanced fuels. In FY 2010: Demonstrate extended duration operation of combined cycle engine regenerative cooling systems with 2nd generation endothermic fuels. Evaluate supersonic combustion of 2nd generation endothermic fuels.		0.500	1.000	1.500	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER 632480

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Identify, develop, and demonstrate low-cost approaches to reducing the fuel logistics footprint for the Expeditionary Air Force. In FY 2008: Developed model for growth and spread of biological materials through fuel handling systems. Demonstrated advanced nano-technology fuel additives, nano-technology fuel sensors, and novel detection and mitigation technologies for biological growth. 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. In FY 2010: Model the spread of biological materials (fungus, bacteria, etc) through fuel handling systems. Demonstrate advanced additives for mitigation of biological growth.	0.500	1.000	1.203	
MAJOR THRUST: Assured Fuels Initiative: 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 2009 due to increased emphasis on development of alternative hydrocarbon jet fuel. In FY 2008: Determined fuel structure changes required to increase specific gravity to 0.775. Determined elastomer swell agents capable of increasing swell to typical JP-8 levels. Began determination of new specification requirements for biomass-derived alternative fuels. In FY 2009: 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 In FY 2010: Investigate biomass-derived fuel and specification requirements. Study elastomer swell agents for 100% synthetic paraffinic kerosene fuels. Initiate study of greenhouse gas footprint assessment for alternative aviation fuels.	2.900	4.000	4.816	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 632480	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Texas Research Institute for Environmental Studies. In FY 2008: Developed a small (air-portable) municipal wastewater treatment system. In FY 2009: Continue with technology development and demonstration of a deployable aerobic aqueous bioreactor that meets EPA standards for safe discharge of municipal wastewater into the environment. In FY 2010: Not Applicable.		1.163	1.596	0.000	
CONGRESSIONAL ADD: Assured Aerospace Fuels Research In FY 2008: Not Applicable. In FY 2009: Create sufficient alternative (non-petroleum) jet fuel to enable fuel composition-versus-properties studies. The facility will also be used for collaborative studies with fuel manufacturers on technology to produce suitable jet fuels for AF use. In FY 2010: Not Applicable.		0.000	1.596	0.000	
CONGRESSIONAL ADD: Bio-JP8 Fuels Research In FY 2008: Not Applicable. In FY 2009: Evaluation of an alternative biofuel production pathway. Currently, hydrotreated fats and oils are expected to be the initial "biokerosene" jet fuels to be evaluated.		0.000	0.798	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 632480	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Renewable Hydrocarbon Fuels for Military Applications (Great Lakes Region) In FY 2008: Not Applicable. In FY 2009: Conduct research to identify the most promising types of algae for use in military applications. In FY 2010: Not Applicable.		0.000	1.995	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER 632480

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603112F/ Advanced Materials for Weapons Systems.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology					PROJECT NUMBER 633035	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
633035: Aerospace Power Technology	13.945	12.030	9.401						Continuing	Continuing

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 is integrated into the Integrated Vehicle Energy Technology (INVENT) and power and thermal programs. This project also develops and demonstrates electrical power and thermal management technologies to enable solid state high power density sources for directed energy weapons.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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 2009 and FY 2010, the efforts in this thrust are reduced due to higher AF priorities. In FY 2008: Performed test of high power megawatt class low duty cycle power generation technology. In FY 2009: Complete analysis of high power magawatt class generator test results. In FY 2010: Initiate development of high energy laser flight demonstration power and thermal managment systems.	1.020	0.396	0.207	
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: Follow-on activities resume in FY 2009 after being delayed in FY 2007 and 2008 due to higher Air Force priorities.	0.000	3.443	3.992	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 633035	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Not Applicable. In FY 2009: Begin design of high temperature demonstrator and fabrication of key components. In FY 2010: Complete detailed design of high temperature, energy optimized demonstrator and initiate fabrication of power and thermal management components.					
MAJOR THRUST: Develop electrical power and thermal management components and subsystem technologies for special purpose applications. Note: Effort completed in FY 2008. In FY 2008: Developed and fabricated high power density and high energy density fuel cell and battery energy storage and power and thermal management/distribution components and subsystems. Performed field tests and demonstrated a 50% weight reduction. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.540	0.000	0.000	
MAJOR THRUST: Develop analytical tools and subsystems for multi-megawatt superconducting electrical power systems including power generation, conditioning, thermal management, and dynamic interaction. Note: Effort completed in FY 2008. In FY 2008: Designed and fabricated multi-megawatt superconducting power and thermal management components. In FY 2009: Not Applicable.		3.150	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology		PROJECT NUMBER 633035	
B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.				
MAJOR THRUST: Develop power and thermal management components and subsystems technologies for fielded and future high power aircraft systems applications. These technologies will enable efficient power and thermal management acquisition, storage, and transport for power on demand with increased system reliability and affordability. Note: In FY 2009 the efforts within this thrust were broken out from other efforts within this Project due to increased emphasis on component and subsystem development in support of energy optimized, high power aircraft systems providing near to far-term thermal management improvements for manned and unmanned aircraft. In FY 2008: Not Applicable. In FY 2009: Investigate, design, and develop efficient, lightweight, wide temperature range, rugged/robust power electronics, motor controls, actuators, heat exchangers, and thermal management components and subsystems. In FY 2010: Fabricate rugged/robust power electronics, motor controls, high performance electric actuators, and adaptive power and thermal management subsystems. Develop subsystems modifications to support integrated subsystems testing.	0.000	5.000	4.856	
MAJOR THRUST: Develop hybrid electrical power and thermal management components and subsystem technologies for special purpose applications. These technologies will enable long endurance small Unmanned Aerial Systems (UAS). Note: This is a continuation of the fuel cell and battery work previously applied to BAO kit. A new thrust was started to clearly show application of these technologies to Unmanned Aerial Systems (UAS). In FY 2008: Not Applicable.	0.000	0.000	0.346	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 633035	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Not Applicable. In FY 2010: Investigate optimization of advanced hybrid fuel cell/battery subsystem designs to achieve minimum volume/weight, maximum power/energy density, and increased battery/fuel cell ruggedness, efficiency, and reliability. Assess hybrid energy management systems for expanded special purpose applications to address needed strike, intelligence, surveillance, and reconnaissance capabilities. Integrate hybridized energy electrical power and thermal management components with end-user operational subsystems such as sensors and communication devices.					
CONGRESSIONAL ADD: Field Renewable Energy System Hybrids (FRESH) Li Ion Battery Program. In FY 2008: Investigated, designed, and developed lightweight rechargeable batteries for airman portable power applications enabling carry lightweight energy systems in the field for sustained operations using renewable/portable energy sources. Focused on decreased size/weight of batteries; increased energy density and extreme environmental functionality, and implementing state-of-charge communication. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.968	0.000	0.000	
CONGRESSIONAL ADD: Development of Bi-Polar Wafer-cell NI-MH battery. In FY 2008: Modified the existing Ni-MH battery bipolar wafer cell design and chemistry for use with Li-ion technology for potential application in the F-35 aircraft in both the 28 V and the 270 V batteries. Demonstrated and delivered a prototype 28 V Li-ion cell pack. In FY 2009: Not Applicable.		1.938	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 633035	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Silicon Carbide (SiC) Power Electronics for More Electric Aircraft. In FY 2008: Developed JFET technologies, beyond FY07 accomplishments, for large area devices rated at 800 and 1200V for enhancement mode VJFETs with low specific on-resistance. In FY 2009: Development of reliable, high voltage(600-1200V), high current(50-100A/die) enhancement mode vertical junction field effect transistors and Schottky diodes, manufacturing yield limiter evauation and enhancement, applications engineering, and reliability testing. In FY 2010: Not Applicable.		5.329	3.191	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER 633035

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602201F/ Aerospace Flight Dynamics.	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0602605F/ Directed Energy Technology.	0.000	0.000							Continuing	Continuing
PE 0603605F/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology					PROJECT NUMBER 634921	
COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
634921: Aircraft Propulsion Subsystems Int	25.870	47.451	36.568						Continuing	Continuing

Note

Note: The funding in this project has been increased in FY 2009 due to emphasis on component development in support of adaptive cycle technologies.

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 has 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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.	1.146	1.621	2.625	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 634921	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Began 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. 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. In FY 2010: Conduct preliminary design and begin detailed design of advanced features for durable fans, turbines, mechanical systems, interactions between the inlet and fan, and controls/accessories. To include advanced cooling design for low pressure turbine blades, health monitoring, light weight externals, and repair validation.					
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 and component development in support of adaptive cycle technologies. In FY 2008: Finished rig testing of lightweight high bypass engine components (utilizes a hollow fan and radial compressor) capable of operating as primary propulsion or in a lift mode. Began 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. Finished preliminary design of advanced adaptive cycle (third air stream) engine technologies, including an advanced fan, high work variable low turbine for long dwell time, controls, inlet integration, and advanced		9.686	33.650	28.949	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER 634921

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
exhaust nozzle for subsonic to sustained supersonic flight. Began detailed design and procurement of long lead hardware for an advanced adaptive cycle (third air stream) engine technologies, including an advanced fan, high work variable low turbine for long dwell time, controls, inlet integration, and advanced exhaust nozzle for subsonic to sustained supersonic flight. 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. Finish detailed design of advanced adaptive cycle (third air stream) engine technologies, including an advanced fan, high work variable low turbine for long dwell time, controls, inlet integration, and advanced exhaust nozzle for subsonic to sustained supersonic flight. Finish procurement of long lead hardware for an advanced fan, high work variable low turbine for long dwell time, controls, inlet integration, and advanced exhaust nozzle for subsonic to sustained supersonic flight. Initiate conceptual design for a high bypass/high overall pressure ratio engine for improved fuel consumption. In FY 2010: Finish assembly 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. Fabricate advanced adaptive cycle (third air stream) engine technologies, including an advanced fan, high work variable low turbine for long dwell time, controls, inlet integration, and advanced exhaust nozzle for subsonic to sustained supersonic flight. Conduct preliminary design for a high bypass/high overall pressure ratio engine for improved fuel consumption.				
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. Note: In FY 2010 funding dips to account for higher Air Force priorities. In FY 2008: Finished fabrication of engine components of advanced high temperature cooled turbine blade and combustor for UAV applications. Finished fabrication and began assembly of advanced components for technologies for engine testing to include an advanced lightweight fan/compressor, turbines with new advanced	6.989	6.994	4.994	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 634921	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
cooling approaches, oil-less bearings and high through flow combustors for missile applications. Began 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. In FY 2009: Finish 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 high mach missile applications. Initiate design of a higher specific thrust low cost expendable turbine engine for improved fuel efficiency improving range. Initiate design of low spool components for fuel efficient subsonic unmanned turbofan engines. In FY 2010: Conduct preliminary design of a higher specific thrust low cost expendable turbine engine for improved fuel efficiency improving range. Conduct preliminary design of advanced fan, advanced low spool turbine, and advanced engine components for improved fuel efficient subsonic unmanned turbofan engines.					
CONGRESSIONAL ADD: Versatile Affordable Advance Turbine Engine (VAATE)-Small Turbofan (STF). In FY 2008: Added additional high pressure turbine component test time, additional engine core test time, conceptual studies for Revolutionary Hunter-Killer core applications with air framers, and cover hardware costs. In FY 2009: Support the ongoing engine demonstrator, design and hardware, tip treatments for high pressure compressor, and thermal mechanical fatigue analysis/design for the turbine. In FY 2010: Not Applicable.		3.488	3.590	0.000	
CONGRESSIONAL ADD: Versatile Affordable Advance Turbine Engine (VAATE), High Speed Turbine Demonstrator.		4.561	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 634921	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Developed an advanced variable nozzle design, developed hardware materials process, and continued risk reduction efforts for the high speed engine demonstrator. In FY 2009: Not Applicable. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Small Adaptive Cycle Turbine Engines In FY 2008: Not Applicable. In FY 2009: Perform risk reduction for an advanced cooled metal turbine and for an advanced high tempurature rear bearing. In FY 2010: Not Applicable.		0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER 634921

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities	0.000	0.000							Continuing	Continuing
PE 0602201F/ Aerospace Flight Dynamics.	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0603003A/ Aviation Advanced Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology					PROJECT NUMBER 634922	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
634922: Space & Missile Rocket Propulsion	4.525	5.068	29.648						Continuing	Continuing

Note

Note: In FY10, this work was moved from Project 10SP within this Program Element to better align efforts.

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced and innovative low-cost rocket turbo-machinery 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 (TSSS) Phase II (including solid boost/missile propulsion, Post Boost Control, and aging and surveillance efforts) and tactical rockets. 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 20-50 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. Aging and Surveillance efforts for solid rocket motors could reduce lifetime prediction uncertainties for individual motors by 50 percent, enabling motor replacement for cause. The efforts in this project contribute to the Technology for the Sustainment of Strategic Systems (TSSS) program and 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. Note: In FY10, Funds from Project 10SP have been moved to Project 4922 within this Program Element to more accurately align efforts.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch vehicles. In FY 2008: Not applicable. In FY 2009: Not applicable.	0.000	0.000	21.438	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 634922	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Complete advanced cryogenic upper stage hardware testing to validate and verify modeling and simulation tools developed. Continue development of 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. Initiate scale-up efforts for engine health management concepts, tools, and technologies to enable real-time assessment and management of highly reusable liquid rocket engines.					
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. In FY 2008: Not applicable. In FY 2009: Not applicable. In FY 2010: Initiate scale-up of electric propulsion technologies for spacecraft with the need for high mobility on orbit. Continue hardware scale-up for an advanced multi-mode (high thrust or high efficiency) propulsion system for satellites. Complete demonstration of advanced chemical propulsion system for satellites.		0.000	0.000	1.051	
MAJOR THRUST: Develop electric and advanced chemical based monopropellant propulsion technologies for future satellite propulsion systems. Phases are referring to IHPRPT program phases. In FY 2008: Not applicable. In FY 2009: Not applicable.		0.000	0.000	5.065	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Complete development and demonstration of IHPRPT Phase III monopropellant thruster technologies for spacecraft. Initiate scale-up of next generation of chemical thrusters for spacecraft propulsion systems.				
MAJOR THRUST: Develop and demonstrate missile propulsion and Post Boost Control Systems (PBCS) technologies for ballistic missiles. Note: Efforts within this thrust will be extended from FY 2008 to be completed following the second Missile Propulsion Demonstration in FY 2009. In FY 2008: Prepared for testing of second of two motors for the Missile Propulsion Demonstration Phase I. In FY 2009: Complete testing of motor demonstrating TSSS Phase I goals. In FY 2010: Not Applicable.	3.805	3.627	0.000	
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. In FY 2008: Developed 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. In FY 2009: Conduct sub-scale component developments providing sub-scale validation of modeling and simulation tools. In FY 2010: Conduct sub-scale component developments providing sub-scale validation of modeling and simulation tools.	0.220	0.687	1.780	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER 634922

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and demonstrate aging and surveillance technologies for strategic systems to reduce lifetime prediction uncertainties for individual motors by 50 percent, enabling motor replacement for cause. Efforts support the Technology for Sustainment of Strategic Systems Phase II. In FY 2008: Conducted 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. In FY 2009: Conduct full-scale demonstration of advanced aging and surveillance tools for solid rocket motors to validate and verify modeling and simulation tools and component technologies. In FY 2010: Conduct full-scale demonstration of advanced aging and surveillance tools for solid rocket motors to validate and verify modeling and simulation tools and component technologies.	0.500	0.754	0.314	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER 634922

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0602601F/ Spacecraft Technology.	0.000	0.000							Continuing	Continuing
PE 0603401F/ Advanced Spacecraft Technology.	0.000	0.000							Continuing	Continuing
PE 0603500F/ Multi-Disciplinary Advanced Development Space Technology.	0.000	0.000							Continuing	Continuing
PE 0603853F/ Evolved Expendable Launch Vehicle Program.	0.000	0.000							Continuing	Continuing
PE 0603114N/ Power Projection Advanced Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER 634922

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology					PROJECT NUMBER 635098	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635098: Advanced Aerospace Propulsion	20.917	22.921	23.940						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and demonstrate technologies for a hydrocarbon-fueled scramjet with robust operation over a range of Mach 4 to 8. In FY 2008: Completed fabrication of air vehicle flight hardware and finalized flight test preparations at supporting test centers (Air Force Flight Test Center and Point Mugu Test Center). In FY 2009: Conduct integrated air vehicle/propulsion flight tests and conduct post test data reduction and reporting. In FY 2010: Complete integrated air vehicle/propulsion flight tests; conduct post test data reduction and write X-51A final report. Demonstrate small scale scramjet engine to Technology Readiness Level 6.	20.917	22.921	23.940	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER 635098

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ PE060203F, Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
Activity Not Provided/This project will be coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology					PROJECT NUMBER 63681B	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
63681B: Advanced Turbine Engine Gas Generator	32.994	51.480	64.100						Continuing	Continuing

Note

Note: The funding has been increased in FY 2009 and 2010 due to emphasis on component development in support of adaptive cycle demonstrations, highly efficient embedded turbine engines, and small heavy fueled engines.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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,	20.026	40.075	51.695	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER 63681B

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
survivable, durable, more responsive systems with longer range and greater payloads for long range strike capability. Note: Funding increased in FY 2009 and 2010 to complete hardware fabrication and conduct engine demonstrations. In FY 2008: Completed fabrication and initiated instrumentation and assembly of advanced core engine components, including advanced turbine 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. Completed detailed design, fabricated and tested rig hardware for a tip turbine concept, including a novel compression system, innovative annular combustor, and advanced rotating seals. Completed design and fabrication of unique compression system components. Initiated preliminary design of high temperature capable, durable compressor, combustor, and turbine for sustained supersonic long range strike core engine. In FY 2009: Complete assembly and demonstration of advanced core engine components, including advanced turbine 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, 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. Conduct conceptual design and initiate preliminary design of component technologies for a core-centric durability engine demonstration. Conduct preliminary design of component technologies for increased reliability, maintainability, and affordability for potential transition to fielded systems. Conduct analysis and conceptual design of system level technologies and weapon systems integration on core engine performance. In FY 2010: Complete detailed design and initiate hardware fabrication of high temperature capable, durable compressor, combustor, and turbine for sustained supersonic long range strike core engine. Complete preliminary design and initiate detailed design of component technologies for a core-centric durability engine demonstration. Conduct detailed design of component technologies for increased reliability, maintainability, and affordability for potential transition to fielded systems. Conduct analysis and conceptual design of system level technologies and weapon systems integration on core engine performance.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 63681B	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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 reconnaissance, intertheater/intratheater transports, subsonic Unmanned Air Systems (UAS), and powered munitions. In FY 2008: Completed detailed design and initiated fabrication 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. Created preliminary design of UAS small versatile affordable advanced core engine technologies including an efficient high pressure compressor, a high heat release combustor, and high performance turbine, and systems for thermal management and advanced power extraction. In FY 2009: Complete fabrication, 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. 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. Conduct preliminary design of efficient small scale propulsion technologies, including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling effectiveness or uncooled turbine, for use in UAS applications.		12.000	11.405	12.405	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER 63681B	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Complete preliminary design and initiate long lead fabrication 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. Complete 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. Complete preliminary design and initiate long lead fabrication of efficient small engine component technologies including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling effectiveness or uncooled turbine, for use in UAS applications.					
CONGRESSIONAL ADD: Ceramic Matrix Composite (CMC) Airfoil Capability Enhancements. In FY 2008: Demonstrated CMC airfoil fabrication capability enhancements for application to advanced aerospace gas turbines. The focus was on the design, fabrication, and testing of critical airfoil sub-elements. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.968	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER 63681B

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602201F/ Aerospace Flight Dynamics.	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0603003A/ Aviation Advanced Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603231F Crew Systems and Personnel Protection Technology					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	36.084	36.411	0.000						Continuing	Continuing
632830: Decision Effectiveness Technology	28.020	25.705	0.000						Continuing	Continuing
634924: Warfighter Readiness Technology	6.091	8.427	0.000						Continuing	Continuing
635020: Bioeffects & Protection Technology	1.973	2.279	0.000						Continuing	Continuing

Note

Note: FY 2008 funding total includes $0.276 million in supplemental funding.

In FY 2010, Decision Effectiveness Technology efforts will move from PE 0603231F, Project 2830 to PE 0603456F, Project 5324, Project 5326, and Project 5327; Warfighter Readiness Technology efforts will move from PE 0603231F, Project 4924 to PE 0603456F, Project 5325; and Bioeffects & Protection Technology efforts will move from PE 0603231F, Project 5020 to PE 0603456F, Project 5323 and Project 5326 to better align efforts. Funds for the FY 2008 Congressionally-directed Virtual Medical Trainer in the amount of $2.4 million are in the process of being moved to the Defense Health Program from PE 0603231F, Crew Systems and Personnel Protection Technology, for execution.

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. 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, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
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B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	38.406	26.630	32.630	
Current BES/President's Budget	36.084	36.411	0.000	
Total Adjustments	-2.322	9.781	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.099		
Total Congressional Increases	0.276	7.480		
Total Reprogrammings	-1.840	2.400		
SBIR/STTR Transfer	-0.758	0.000		

Change Summary Explanation

In FY 2009, Congress added $5.0 million for Air Purification with Carbon Nanotube Nanostructured Material, $2.48 million for PhasorBIRD Helmet Tracker, and $2.4 million for Joint Theater Air Ground Simulation System.

C. Performance Metrics
Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603231F Crew Systems and Personnel Protection Technology					PROJECT NUMBER 632830	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
632830: Decision Effectiveness Technology	28.020	25.705	0.000						Continuing	Continuing

Note

Note: In FY 2010, Decision Effectiveness Technology efforts will move from PE 0603231F, Project 2830 to PE 0603456F, Project 5324, Project 5326, and Project 5327 to better align efforts. Funds for the FY 2008 Congressionally-directed Virtual Medical Trainer in the amount of $2.4 million are in the process of being moved to the Defense Health Program from PE 0603231F, Crew Systems and Personnel Protection Technology, for execution.

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, develop aircrew system technologies to support long duration missions, and improve the manhunt capabilities of AF special operations. The ultimate goal is to assure warfighter decision effectiveness in AF operations.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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/Cyber warrior with tailored decision support systems, guidelines for effective selection of IO/ISR/Cyber warriors, IO/ISR/ Cyber simulators and training systems, enhanced decision-making tools, and automated tools to reduce ever-increasing data load and improve mission accomplishment. Note: In FY 2010, this major thrust will move to PE 0603456F, Project 5324 to better align efforts. In FY 2008: Developed and demonstrated the utility and effectiveness of ISR operator planning tools. Developed and demonstrated operator-aiding technologies to exploit data from new ISR sensors and reduce data overload. Expanded IO/ISR training research and evaluated new regimens to address training for new	2.277	2.685	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
ISR missions. Developed Influence Operations technologies and facilitated transition into follow-on IO/ISR operator workload optimization development. In FY 2009: Design advanced IO/ISR/Cyber technologies and demonstrate next-generation IO/ISR/Cyber 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/Cyber operators. Initiate advanced Cyber influence development. In FY 2010: Not Applicable.					
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). Note: In FY 2010, this major thrust will move to PE 0603456F, Project 5324 to better align efforts. In FY 2008: Developed a predictive analysis tool based on continuous and dynamic operational effects assessment. Based on operator field test results, developed enhancements that foster command level interaction with the visualization tool for rapid and actionable decision-making. In FY 2009: Integrate 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. In FY 2010: Not Applicable.		1.938	1.891	0.000	
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		3.701	3.884	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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 unmanned aerial vehicles (UAV). Employ real-time wargaming simulations and field tests to quantify the decision-making benefits from advanced control/display portrayal concepts that optimize net-centric information flow to system operators. Note: In FY 2010, this major thrust will move to PE 0603456F, Project 5327 to better align efforts. In FY 2008: Commenced 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. Demonstrated 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. Provided 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. Demonstrated user-independent speech recognition and language translation customized for ground controller equipment and TAC earplug microphones. Began hardware and software implementation of a supervisory control station technology baseline. Began concept development for a next-generation supervisory control station, and assessed projected benefits in terms of operator mission performance and overall usability relative to the technology baseline station. 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 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.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
MAJOR THRUST: Develop and demonstrate decision-aiding technologies that assist the Joint Forces Commander (JFC)/Joint Forces Air Component Commander (JFACC) to rapidly assess the battlefield situation, predict the most likely adversary behaviors, and select and prioritize the appropriate courses of action. Note: In FY 2010, this major thrust will move to PE 0603456F, Project 5324 to better align efforts. In FY 2008: Completed the first spiral development of CPE decision aids and simulation based on global strike and global persistent attack missions. Planned a technology demonstration program to evaluate benefits and utility of tools. Expanded the scope of the scenario-based cognitive work to include non-traditional warfare such as humanitarian relief and global war on terrorism. Began a cognitive work analysis with this expanded scope. 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. In FY 2010: Not Applicable.		2.043	2.225	0.000	
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. Note: In FY 2010, this major thrust will move to PE 0603456F, Project 5326 to better align efforts. In FY 2008: Selected the best emerging technologies for bio-taggant and threat neutralization applications and developed those technologies into fieldable counterproliferation capabilities. Used aptamer-based technology		1.493	1.552	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
to enhance the effectiveness of the cold plasma and directed energy technologies. Developed the capability to attach quantum dots and mixed-metal nanoparticles to aptamers to serve as taggants for biological agents. 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. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop and demonstrate intelligent software agents, realistic human and organizational behavior models, and advanced job performance aiding technologies. Computer agents and models add realism and fidelity to large-scale synthetic environments and war games, and provide intelligence analysts a way to model collected data. Job aiding technologies provide command and control (C2) operators with automated access to a manageable amount of multi-source critical information to avoid operator overload and to support fast and accurate decision-making during mobility operations. Note: Decreased emphasis in FY 2009 reflects completion of advanced demonstration effort in FY 2008. In FY 2010, this major thrust will move to PE 0603456F, Project 5324 to better align efforts. In FY 2008: Developed and experimented with system-of-systems societal modeling, increasing the complexity and degree of dynamic change. Expanded development of work-centered collaborative planning, analysis, and decision-making software tools into the unstructured C2 work environment of dynamic mission re-synchronization. Investigated the value of implementing human-computer interfaces as services or as service layers of an enterprise architecture. 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.		4.490	1.166	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Not Applicable.				
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. Note: In FY 2009, this effort terminates due to higher AF priorities. In FY 2008: Evaluated methods for organizational impact analysis of new information and network-based tools to support collaborative logistics. Collected human-centric performance data from critical experiments and joint exercises to benchmark improvements in maintenance, transportation, and supply functions in contingency support. 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. In FY 2010: Not Applicable.	1.221	0.895	0.000	
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. Note: In FY 2010, this major thrust will move to PE 0603456F, Project 5327 to better align efforts.	1.726	1.933	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Analyzed 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. Conducted 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. 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. In FY 2010: Not Applicable.				
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 was discontinued to align work with higher AF priorities. In FY 2008: Validated system specification through testing of candidate seat system designs. Researched and developed seat system technologies to improve performance, safety, and comfort. Demonstrated performance of candidate seat system optimization technologies. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	0.751	0.000	0.000	
MAJOR THRUST: Develop and demonstrate technologies for improved force protection, the maintenance of peak warfighter performance in known toxic environments, and the identification of difficult-to-detect enemy threats. 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. Develop model-based	0.892	2.015	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
threat awareness, health status, visualization, risk assessment technologies, and intent of human adversaries. Note: In FY 2010, this major thrust will move to PE 0603456F, Project 5326 to better align efforts. In FY 2008: Developed detection technologies to identify kidney and liver organ selective degradation using streamlined, yet robust, assay procedures and biomarkers. Generated 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. 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. Develop predictive human models for threat detection and exposure. Develop enhanced anthropometric visualization techniques that integrate heterogeneous sensor data of potential adversaries. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Variable Transmittance Visor. In FY 2008: Conducted Congressionally-directed effort for Variable Transmittance Visor. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.972	0.000	0.000	
CONGRESSIONAL ADD: Low Cost/Improved Performance for Helmet Display and Life Support Technologies.		2.626	0.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Conducted Congressionally-directed effort for Low Cost/Improved Performance for Helmet Display and Life Support Technologies. In FY 2009: Not Applicable. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Battlefield Automatic Life Status Monitor (BALSM). In FY 2008: Conducted Congressionally-directed effort for BALSM. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.556	0.000	0.000	
CONGRESSIONAL ADD: Water Purification with Fused Carbon Nanotube Nanostructured Material. In FY 2008: Conducted Congressionally-directed effort for Water Purification with Fused Carbon Nanotube Nanostructured Material. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		2.334	0.000	0.000	
CONGRESSIONAL ADD: Air Purification with Carbon Nanotube Nanostructured Material.		0.000	4.986	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Air Purification with Carbon Nanotube Nanostructured Material. In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: PhasorBIRD Helmet Tracker. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for PhasorBIRD Helmet Tracker. In FY 2010: Not Applicable.	0.000	2.473	0.000	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0603456F/ Human Effectiveness Adv Tech Dev.	0.000	0.000							Continuing	Continuing
PE 0604706F/ Life Support Systems.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
634924: Warfighter Readiness Technology	6.091	8.427	0.000						Continuing	Continuing

Note

Note: In FY 2010, Warfighter Readiness Technology efforts will move from PE 0603231F, Project 4924 to PE 0603456F, Project 5325 to better align efforts.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Developed integrated methods for assessing and tracking performance in live, virtual, and constructive environments. Developed and demonstrated integrated readiness assessment for air-to-air, air-to-ground, close air support, and C2. Demonstrated interface and training capability between DMO and live range exercises. Developed scenario authoring shells amenable for guiding training and learning in virtual and live contexts. Developed integrated methods for evaluating the impact of different levels of fidelity in simulation environments on performance and readiness. Finalized the development of functional requirements for managing learning in distributed training contexts.	2.970	2.692	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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 (JCAS) environment for schoolhouse training. Demonstrate and validate technology alternatives for in-garrison and field deployable JCAS training and rehearsal system. Initiate development of specifications for integrating forward deployed battlefield coordination and command simulation with JCAS schoolhouse training. Demonstrate embedded training and performance assessment in a deployed combat training environment. Demonstrate integrated deployed DMO capability in large scale Live, Virtual, and Constructive (LVC) event. Demonstrate quantitative methods for certifying simulation fidelity and readiness training capabilities. In FY 2010: Not Applicable.					
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. In FY 2008: Performed engineering and human factors analyses of the Combat Immersive Visual Environments for Distributed Mission Operations (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. In FY 2009: Develop CIVE head-mounted and compact off-the-head display/image generation proof of concept component demonstrations. Begin human factors analyses and technology performance evaluations of the concept demonstrations. In FY 2010: Not Applicable.		1.276	1.192	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Developed competency-based training requirements for team and functional areas within strategy and plans divisions including IO and ISR teams. Developed optimum training and mission rehearsal strategies to employ information simulation into AOC weapon systems planning tools. Surveyed instructional methods for employment in targeted training of mission-essential knowledge and skills and developed most capable method(s) for integration. Designed and developed architectures and hardware that integrate live EW range data into shared networked simulations. Developed a simulation of an advanced fighter-specific EW sensor suite for DMO application. Demonstrated guiding a single EW training illuminator on a live electronic combat range with fully integrated, computer-generated, and live forces. In FY 2009: Develop integrated strategy and plans division trainer based on competency-based training requirements and optimum mission rehearsal strategies. 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	1.845	2.150	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
training capability on airborne aircraft and design systems and demonstrate these technologies during a live-fly exercise at an EW training range. In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: Joint Theater Air Ground Simulation System. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Joint Theater Air Ground Simulation System. In FY 2010: Not Applicable.	0.000	2.393	0.000	

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APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER 634924

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0603456F/ Human Effectiveness Adv Tech Dev.	0.000	0.000							Continuing	Continuing
PE 0604227F/ Distributed Mission Training.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603231F Crew Systems and Personnel Protection Technology					PROJECT NUMBER 635020	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635020: Bioeffects & Protection Technology	1.973	2.279	0.000						Continuing	Continuing

Note

Note: In FY 2010, Bioeffects & Protection Technology efforts will move from PE 0603231F, Project 5020 to PE 0603456F, Project 5323 and Project 5326 to better align efforts.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and demonstrate technologies that permit safe testing, deployment, and use of high energy laser weapons and systems. Note: In FY 2010, this major thrust will move to PE 0603456F, Project 5323 to better align efforts. In FY 2008: Released laser range safety software tool including dynamic bi-directional reflectivity distribution function to support live fire test of major systems. Initiated validation, verification, and accreditation package for new software package. Assessed probabilistic risk assessment for use with laser hazard assessment. 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. In FY 2010: Not Applicable.	0.769	0.875	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER 635020

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and demonstrate technologies to assess bioeffects and protection from radio frequency (RF) systems, including terahertz technologies. Note: In FY 2010, this major thrust will move to PE 0603456F, Project 5323 to better align efforts. In FY 2008: Initiated program to develop solutions for both laser and other non-ionizing radiation to personnel. Integrated laser solutions into solutions for RF, microwave, terahertz, and other regimes of electromagnetic radiation for personnel protection. In FY 2009: Continue to develop laser and RF and other non-ionizing protective solutions for personnel protection. Develop bioeffects-based fire-control algorithms for directed energy weapons. 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. In FY 2010: Not Applicable.	0.798	1.136	0.000	
MAJOR THRUST: Develop and demonstrate ability to support testing of counterforce technologies and to enable man-portable threat neutralization capabilities. Note: In FY 2010, this major thrust will move to PE 0603456F, Project 5326 to better align efforts. In FY 2008: Developed technologies that will provide the capability to neutralize threats without leaving evidence for special applications. Developed technologies to enable safe return and avoid contaminating aircraft or other equipment. 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.	0.235	0.268	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER 635020

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Not Applicable.				
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 completed in FY 2008. In FY 2008: Completed development and demonstrated 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. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	0.171	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER 635020

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0603112F/ Advanced Materials for Weapon Systems.	0.000	0.000							Continuing	Continuing
PE 0603319F/ Airborne Laser Program.	0.000	0.000							Continuing	Continuing
PE 0603456F/ Human Effectiveness Adv Tech Dev.	0.000	0.000							Continuing	Continuing
PE 0604706F/ Life Support Systems.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603231F Crew Systems and Personnel Protection Technology	PROJECT NUMBER 635020

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603270F Electronic Combat Technology					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	26.947	30.241	31.021						Continuing	Continuing
632432: Defensive System Fusion Technology	7.596	11.922	4.567						Continuing	Continuing
63431G: RF Warning & Countermeasures Tech	7.795	9.957	20.159						Continuing	Continuing
63691X: EO/IR Warning & Countermeasures Tech	11.556	8.362	6.295						Continuing	Continuing

Note

Note: Funds for the FY 2008 Congressionally-directed Innovative Polymeric Materials for Three-Dimensional (3-D) Microdevice Construction in the amount of $1.0 million are in the process of being moved from PE 0603270F, Electronic Combat Technology, to PE 0602102F, Materials, for execution.

A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to support Air Force electronic combat warfighting capabilities. The program focuses on developing components, subsystems, and technologies with potential aerospace combat, special operations, and airlift electronic combat applications in three project areas. The first project develops and demonstrates technologies for integrating electronic combat sensors and systems into a fused and seamless whole. The second project develops and demonstrates advanced technologies for radio-frequency (RF) electronic combat suites. The third project develops and demonstrates advanced warning and countermeasure technologies to defeat electro-optical (EO), infrared (IR), and laser threats to aerospace platforms. 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, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603270F Electronic Combat Technology

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	26.762	21.056	16.740	
Current BES/President's Budget	26.947	30.241	31.021	
Total Adjustments	0.185	9.185	0.000	
Congressional Program Reductions	0.000	-0.013		
Congressional Rescissions	0.000	-0.082		
Total Congressional Increases	0.000	10.880		
Total Reprogrammings	0.689	-1.600		
SBIR/STTR Transfer	-0.504	0.000		

Change Summary Explanation

Note: In FY 2009 Congress added +$1.6M for Advanced Electromagnetic Location of IEDs Defeat System, +$1.2M for COTS Analysis Tools for Navigational Warfare, +$1.6M for Innovative Polymeric Materials for Three-Dimensional (3-D) Microdevice Construction, +$1.6M for New Electronic Warfare Specialists Through Advanced Research by Students, and +$4.9M for Advanced Threat Alert/Advance Technology Development.

C. Performance Metrics
Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603270F Electronic Combat Technology					PROJECT NUMBER 632432	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
632432: Defensive System Fusion Technology	7.596	11.922	4.567						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates technologies for integrating electronic combat sensors and electronic combat 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, standoff 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 standoff jammer technologies; and electronic collection methods to inform field commanders of changes in the electronic environment.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop affordable radio-frequency and electro-optical emitter warning and electronic warfare battle management concepts and techniques. Develop techniques for coordination and management of multiple, distributed, jamming nodes against integrated air defense systems. Conduct integrated electronic warfare/information operations simulations and demonstrations for the deception and defeat of integrated air defense system threats. In FY 2008: Completed maturation demonstration of advanced threat alert and jamming subsystem for combat aircraft to increase survivability against advanced, integrated radio-frequency, electro-optical, and infrared air defense systems. Investigated electronic warfare battle management strategies and technical protocols for control of multiple jamming nodes working in coordination against an integrated air defense system in the overall context of non-traditional intelligence, surveillance, reconnaissance and strike operations. Developed and demonstrated technical protocols for the integration of electronic warfare, command-and-control warfare, and information operations against an integrated air defense system. In FY 2009: Conduct analyses and initial demonstrations of electronic warfare battle management strategies in the Air Force Integrated Demonstrations and Applications Laboratory and Virtual Combat Laboratory simulation facilities. Continue to develop and demonstrate technical protocols for the integration of electronic warfare,	5.939	5.858	4.567	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603270F Electronic Combat Technology			PROJECT NUMBER 632432	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
command-and-control warfare and information operations against an integrated air defense system. Develop and mature key technologies essential for Airborne Electronic Attack risk reduction. In FY 2010: Continue research into electronic warfare battle management techniques and protocols in the Virtual Combat Environment for Electronic Conflict. Investigate and demonstrate electronic attack techniques from multiple nodes. Initiate a project to demonstrate a distributed (multi-node) electronic support/electronic attack architecture. Continue research into integration of electronic attack and information operations to defeat an adversary integrated air defense system.					
CONGRESSIONAL ADD: Advanced Threat Alert Advanced Technology Demonstration. In FY 2008: Conducted Congressionally-directed effort for Advanced Threat Alert Advanced Technology Demonstration. In FY 2009: Conduct Congressionally-directed effort for Advanced Threat Alert Advanced Technology Demonstration. In FY 2010: Not Applicable.		1.657	4.867	0.000	
CONGRESSIONAL ADD: Commercial-Off-the-Shelf (COTS) Analysis Tools for Navigational Warfare. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for COTS Analysis Tools for Navigational Warfare. In FY 2010: Not Applicable.		0.000	1.197	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603270F Electronic Combat Technology	PROJECT NUMBER 632432

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603203F/ Advanced Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603500F/ Multi-disciplinary Advanced Space Technology.	0.000	0.000							Continuing	Continuing
PE 0604270F/ Electronic Warfare (EW) Development.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603270F Electronic Combat Technology					PROJECT NUMBER 63431G	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
63431G: RF Warning & Countermeasures Tech	7.795	9.957	20.159						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced technologies for radio-frequency electronic combat suites to enhance the survivability of aerospace vehicles and to provide crew situational awareness. One major area addresses technologies for missile/threat warning, radio-frequency receivers, electronic combat pre-processors, advanced sorting/pre-processing algorithms, and expert software for applications on existing and future electronic combat systems. Another major technology area focuses on the development and demonstration of subsystems and components for generating on-board/off-board radio-frequency countermeasure techniques. This includes the development of electronic countermeasures techniques as well as advanced electronic countermeasures technologies such as antennas, power amplifiers, and preamplifiers.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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 completed in FY 2008. In FY 2008: Completed integration and test of array compatible with unmanned aerial vehicles. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	1.161	0.000	0.000	
MAJOR THRUST: Develop aerospace platform self-protection and mutual support jamming technologies and techniques to counter advanced radio-frequency threats associated with current and future aerospace weapon systems. Develop distributed, coordinated, multi-nodal radar jamming techniques for degradation, deception and neutralization of early warning and surveillance networks to enable all-platform operations in defended adversary airspace. Develop new adaptive electronic attack techniques fusing advanced digital signal processing receivers with digital technique generators.	6.634	6.765	20.159	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603270F Electronic Combat Technology			PROJECT NUMBER 63431G	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Provided hardware simulation and analysis support to multi-intelligence sensor needs for accurate and timely electronic surveillance information. Conducted threat research, simulation, and analysis of early warning radar characteristics. Developed multiple technical strategies and techniques for deceiving them in a network enabled operational environment. Developed advanced simulation capabilities to support network enabled jamming of adversary early warning and surveillance networks. Developed and evaluated integrated digital receiver/jammer architectures. 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 brassboard architectures that leverage real-time electronic surveillance signal processing to enhance electronic attack effectiveness. In FY 2010: Initiate advanced electronic attack jamming algorithms development for network operations to defeat future advanced threats. Continue to research the synergy between electronic protection and electronic attack technologies to realize more effective jamming. Demonstrate a distributed, multi-node electronic support/electronic attack concept. Continue research to tailor electronic attack techniques in combination with simultaneous information operations to counter the increasing adversary air defense systems moves to increased digital integration of defense sensors. Develop and assess advanced technology, concepts, and algorithms to mitigate the effects of advanced signals on radio frequency receiver-processors.					
CONGRESSIONAL ADD: Advanced Electromagnetic Location of IEDs Defeat System. In FY 2008: Not Applicable.		0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603270F Electronic Combat Technology	PROJECT NUMBER 63431G

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Conduct Congressionally-directed effort for Advanced Electromagnetic Location of IEDs Defeat System. In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: New Electronic Warfare Specialists Through Advanced Research by Students. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for New Electronic Warfare Specialists Through Advanced Research by Students. In FY 2010: Not Applicable.	0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603270F Electronic Combat Technology	PROJECT NUMBER 63431G

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0604270F/ Electronic Warfare (EW) Development.	0.000	0.000							Continuing	Continuing
PE 0603500F/ Multi-disciplinary Advanced Space Technology.	0.000	0.000							Continuing	Continuing
PE 0604270N/ EW Development.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603270F Electronic Combat Technology					PROJECT NUMBER 63691X	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
63691X: EO/IR Warning & Countermeasures Tech	11.556	8.362	6.295						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates the advanced warning and countermeasure technologies required to negate electro-optical, infrared, 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 infrared missiles with autonomous seekers, multi-spectral threats, laser-guided weapons, and electro-optical and infrared tracking systems used to direct electro-optical, infrared, and radar-guided missiles.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Analyze the vulnerabilities of current infrared missile systems and future imaging infrared sensors. In FY 2008: Concluded in-house analyses on infrared-guided missile and future imaging infrared sensor susceptibilities. Further evaluated countermeasure techniques for countering multiple types of missiles and imaging infrared sensors. Identified optimal countermeasure techniques to defeat single color imaging infrared sensors. In FY 2009: Perform laboratory analyses on future infrared 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. In FY 2010: Continue to perform laboratory analyses and assessments on infrared guided missiles and future imaging systems. Investigate countermeasures techniques that include laser jamming and jamming, expendables combinations. Conduct digital, injection, hardware-in-loop simulation to develop and assess countermeasures (CM) effectiveness. Obtain imaging threat to enable evaluation of postulated CM concepts. Support major Advanced Technology Demonstrations through Developmental Test and Evaluation.	3.529	4.549	1.664	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603270F Electronic Combat Technology		PROJECT NUMBER 63691X

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop aerospace laser warning sensor technologies for timely alert to advanced laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser-guided ordnance) signals. In FY 2008: Developed laser warning sensors to address emerging laser threats. Initiated development of miniaturized laser warning sensors. Fabricated compact device for personnel protection. Demonstrated capability to geolocate laser threats for enhanced situational awareness. 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. In FY 2010 Further develop laser warning sensors to address emerging laser threats. Demonstrate integration of miniaturized laser warning sensors in sensor protection, personnel protection and countermeasures cueing. Develop laser detection/warning/geolocation concepts for air based defense against medium and high energy lasers. Investigate advanced concepts for laser beam rider (laser augmented manpad) detection and geolocation. Demonstrate hardware-in-the-loop laser threat/sensor engagement testing for mission survivability testing.	0.829	0.939	0.593	
MAJOR THRUST: Develop a countermeasure technology to defeat passive electro-optical and infrared aircraft tracking sensors and ordnance guidance. Note: Funding decrease in FY 2009 is due to completion of tests and demonstrations in FY 2008. In FY 2008: Completed field tests to locate and counter passive threats before threats can develop fire control solution. Completed tower demonstration system development and conduct experiments over 2 km range. Evaluated effectiveness of countermeasure techniques against night vision devices and other passive surveillance sensors.	4.882	2.724	1.672	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603270F Electronic Combat Technology			PROJECT NUMBER 63691X	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2010: Continue development of affordable, lightweight infrared, laser countermeasures capability combing passive surveillance and missile defeat techniques for tactical aircraft. Continue design of capability to geolocation and identify passive infrared threats for targeting.					
MAJOR THRUST: Develop electro-optical/infrared missile warning technologies to alert aircrews and aircraft self-protection systems to the approach of advanced, low-signature threats. In FY 2008: Characterized sensor performance in varied background clutter. Identified maximum detection ranges for high priority threat missiles. In FY 2009: Conduct missile warning sub-system integration of sensor, real-time processor and algorithms for a complete real-time visible missile warning system and for testing of the system in real-time environments. In FY 2010: Integrate visible missile warning system (VMWS) into the Affordable Laser Infrared Survivability System (ALISS).		0.853	0.150	0.148	
MAJOR THRUST: Develop electro-optical sensor component technology to advance multiple space mission areas. Develop new sensor components, topologies, and architectures for space. Note: Prior to FY 2010, this effort was performed in PE 0603203F, Project 88SP. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		0.000	0.000	2.218	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603270F Electronic Combat Technology	PROJECT NUMBER 63691X

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Conduct space situation awareness (SSA) sensor prototype experiments.				
CONGRESSIONAL ADD: Battlefield Laser Detection System (BLADES). In FY 2008: Conducted Congressionally-directed effort for BLADES. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	1.463	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603270F Electronic Combat Technology	PROJECT NUMBER 63691X

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0604270F/ Electronic Warfare (EW) Development.	0.000	0.000							Continuing	Continuing
PE 0603500F/ Multi-disciplinary Advanced Development Space Technology.	0.000	0.000							Continuing	Continuing
PE 0604270N/ EW Development.	0.000	0.000							Continuing	Continuing
PE 0603203F/ Advanced Aerospace Sensors.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	97.639	97.469	83.909						Continuing	Continuing
632181: Spacecraft Payloads	28.478	37.304	26.919						Continuing	Continuing
633834: Integrated Space Technology Demonstrations	32.107	29.208	29.168						Continuing	Continuing
634400: Space Systems Protection	4.001	7.841	8.118						Continuing	Continuing
635021: Space Systems Survivability	4.285	5.158	4.871						Continuing	Continuing
635083: Ballistic Missiles Technology	5.907	5.630	5.982						Continuing	Continuing
63682J: Spacecraft Vehicles	22.861	12.328	8.851						Continuing	Continuing

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. 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, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603401F Advanced Spacecraft Technology

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	100.600	80.958	84.853	
Current BES/President's Budget	97.639	97.469	83.909	
Total Adjustments	-2.961	16.511	0.000	
Congressional Program Reductions	0.000	-0.047		
Congressional Rescissions	0.000	-0.264		
Total Congressional Increases	0.000	17.622		
Total Reprogrammings	-1.009	-0.800		
SBIR/STTR Transfer	-1.952	0.000		

Change Summary Explanation

Changes to this PE since the previous President's Budget are due to higher Air Force priorities.

Note: In FY 2009, Congress added $1.6 million for Small Low Cost Reconnaissance Spacecraft Components; $1.2 million for Space Situational Awareness; $2.2 million for Semiconductor Optical Amplifier for Responsive Space MPOI; $1.6 million for Integrated Spacecraft Engineering Tool (ISET); $2.4 million for Micromachined Switches for Next Generation Modular Satellites; $1.75 million for Satellite Coherent Optical Receiver (SCORE); $1.272 million for Operational Responsive Space Architecture for Dual Use Applications; $1.6 million for Thin Film Amorphous Solar Arrays, and $3.2 million for Ultra Low Power Electronics. Congress also added $0.8 million for Hybrid Sounding Rocket Propulsion that has been moved to PE 0603216F, Aerospace Propulsion and Power Technology, Project 10SP, for execution.

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology					PROJECT NUMBER 632181	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
632181: Spacecraft Payloads	28.478	37.304	26.919						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop spacecraft microelectronic devices, including radiation-hardened data processors and ultra-high density strategically hardened memories, space-qualifiable, high density advanced packaging technology, and micro-electro-mechanical systems (MEMS) components and applications. Note: In FY 2009, decreased emphasis on conventional radiation-hardened electronics. In FY 2008: Developed capabilities to the current Satellite Design Automation software to evolve a logical sequence to form a "push-button toolflow" satellite builder. Developed radiation-hardened space sensor interface modules allocating standardized data messages protocols from sensors for ease device control of sensors and actuators. 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-hardened space sensor interface modules allocating standardized data messages protocols from sensors for ease device control of sensors and actuators.	10.047	8.680	8.529	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER 632181	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Demonstrate improved radiation-hardened space sensor interface modules allocating standardized data messages protocols from sensors for ease device control of sensors and actuators. Continue development of high-density volatile memory. Initiate multiprocessor architecture development.					
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. Note: In FY 2010, increased emphasis on responsive space technologies. In FY 2008: Refined command, control, guidance, and navigational capabilities for space superiority. Integrated autonomous flight software technologies with command, control, guidance, and navigation technologies. Extended hardware-in-the-loop testbed, spacecraft command and telemetry simulations, and mission ops centers. Explored development of modeling command, control, and communications systems, conducted engineering trades, and performed military utility analysis. In FY 2009: Complete development of command, control, guidance, and navigational capabilities for space superiority. 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. In FY 2010: Continue to model command, control, and communications systems, conduct engineering trades, and perform military utility analysis for space superiority. Initiate rapid spacecraft development processes to include automated spacecraft design, rapid assembly, automated flight and ground software configuration, and expedited integration and test.		2.324	2.574	4.072	
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		0.618	5.954	6.840	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER 632181	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
flight experiments. Note: In FY 2009 and out, increased emphasis on space superiority and responsive space technologies. In FY 2008: Developed space-based communications models for blue force situational awareness, communications on the move, and data exfiltration. Completed development of models of responsive or reconfigurable technologies. Applied 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. 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, technology trades, mission planning and operations, and utility analysis to autonomous rendezvous/ proximity operations flight experiments for space situational awareness, tactical satellites for Intelligence, Surveillance, and Reconnaissance (ISR) and responsive space, and defensive space control technology experiment/demonstration. Integrate previously developed military utility analysis tools into systems-level analysis tools. In FY 2010: Continue physics-to-engineering-to-engagement level models for systems engineering, technology trades, mission planning and operations, and utility analysis for systems-level analysis, experimental support, and concept of operations of flight programs. Complete integration of tools to model detection, identification, and characterization technologies for situational awareness. Refine and validate military utility and sensor analysis tools for external organizations. Perform military utility analyses for flight programs.					
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.		4.270	5.580	5.895	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER 632181	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Performed studies for detectors and readouts needed for exquisite imaging. Increased size/speed of Radiation Hardened by Design Readout Integrated Circuits (RHBD ROICs). Folded radiation hardness improvement of visible sensor with RHBD ROIC into full focal plane array. In FY 2009: Begin full focal plane array for exquisite imaging. Develop visible sensor for potential transition. In FY 2010: Continue full focal plane array for exquisite imaging. Complete visible sensor development. Develop higher operating temperature sensors. Develop large format infrared sensors.					
MAJOR THRUST: Develop technologies for multi-access laser communications space terminals with reduced weight, power, and cost for transformational communications. Note: In FY 2009, efforts for multi-access laser communications are complete. In FY 2008: Completed multi-access laser communications terminal form-fit-function development. Completed environmental testing of multi-access laser communications terminal components and subsystems in relevant laboratory environment. In FY 2009: Develop key scientific performance parameters appropriate for future space communications needs. In FY 2010: Not Applicable.		0.916	0.801	0.000	
MAJOR THRUST: Develop spectral/polarimetric sensing and data exploitation demonstrations for military imaging and remote sensing applications. Note: Beginning in FY 2009, increased emphasis on space situational awareness technologies. In FY 2008: Collected laboratory data of satellites using spectral/polarimetric sensing and demonstrated applicability of techniques for space situational awareness.		0.172	1.326	1.583	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER 632181	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Compare measurements of satellites to predictive models and determine the feasibility of model based exploitation for space situational awareness. In FY 2010: Initiate studies and analyses of integrated RF/optical/polarimetric sensing techniques.					
CONGRESSIONAL ADD: Systemic Hierarchical Approach to Radiation Hardened Electronics. In FY 2008: Conducted Congressionally-directed effort for Systemic Hierarchical Approach to Radiation Hardened Electronics. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		2.338	0.000	0.000	
CONGRESSIONAL ADD: Intelligent Free Space Optical Satellite Communications Node. In FY 2008: Conducted Congressionally-directed effort for Intelligent Free Space Optical Satellite Communications Node. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.558	0.000	0.000	
CONGRESSIONAL ADD: COTS Technology for Situational Space Awareness.		1.949	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER 632181	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Conducted Congressionally-directed effort for COTS Technology for Situational Space Awareness. In FY 2009: Not Applicable. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Satellite Coherent Optical Receiver (SCORE). In FY 2008: Conducted Congressionally-directed effort for Satellite Coherent Optical Receiver (SCORE). In FY 2009: Conduct Congressionally-directed effort for Satellite Coherent Optical Receiver (SCORE). In FY 2010: Not Applicable.		1.948	1.745	0.000	
CONGRESSIONAL ADD: Micromachined Switches for Next-Generation Modular Satellites. In FY 2008: Conducted Congressionally-directed effort for Micromachined Switches for Next-Generation Modular Satellites. In FY 2009: Conduct Congressionally-directed effort for Micromachined Switches for Next-Generation Modular Satellites. In FY 2010: Not Applicable.		2.338	2.394	0.000	
CONGRESSIONAL ADD: Integrated Spacecraft Engineering Tool (ISET).		0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER 632181	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Integrated Spacecraft Engineering Tool (ISET). In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Operational Responsive Space Architecture for Dual Use Applications. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Operational Responsive Space Architecture for Dual Use Applications. In FY 2010: Not Applicable.		0.000	1.269	0.000	
CONGRESSIONAL ADD: Semiconductor Optical Amplifier for Responsive space MPOI. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Semiconductor Optical Amplifier for Responsive space MPOI. In FY 2010: Not Applicable.		0.000	2.194	0.000	
CONGRESSIONAL ADD: Ultra Low Power Electronics.		0.000	3.191	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 632181

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Ultra Low Power Electronics. In FY 2010: Not Applicable.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 632181

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0303601F/ MILSTAR Satellite Communications System.	0.000	0.000							Continuing	Continuing
PE 0305160F/ Defense Meteorological Satellite Program (DMSP).	0.000	0.000							Continuing	Continuing
PE 0602601F/ Spacecraft Technology.	0.000	0.000							Continuing	Continuing
PE 0603311F/ Ballistic Missile Technology.	0.000	0.000							Continuing	Continuing
PE 0603215C/ Limited Defense System.	0.000	0.000							Continuing	Continuing
PE 0603218C/ Research and Support.	0.000	0.000							Continuing	Continuing
PE 0603226E/ Experimental Evaluation of Major Innovative Technologies.	0.000	0.000							Continuing	Continuing
PE 0604609F/ Reliability and Maintainability Technology Insertion Program (RAMTIP).	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to	0.000	0.000							Continuing	Continuing

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 632181

harmonize efforts and
eliminate

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology					PROJECT NUMBER 633834	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
633834: Integrated Space Technology Demonstrations	32.107	29.208	29.168						Continuing	Continuing

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 U.S. 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Completed system level integration of payload and microsatellite and complete functional and environmental tests of integrated system. Integrated with launch vehicle. Integrated ground control system and satellite software simulations. Performed simulated mission operations for missions operations training. In FY 2009: Launch and complete autonomous flight demonstration. Develop next in the series of satellite design(s). Initiate procurement of bus and payload hardware. In FY 2010: Complete lightweight visible and infrared sensors calibration and integration. Complete all integration for experimental microsatellite for geosynchronous orbit. Complete microsatellite-launch vehicle integration. Design and complete flight rehearsals prior to launch.	30.549	29.208	29.168	
CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.	1.558	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 633834

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction. In FY 2009: Not Applicable. In FY 2010: Not Applicable.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602601F/ Spacecraft Technology.	0.000	0.000							Continuing	Continuing
PE 0603605F/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology					PROJECT NUMBER 634400	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
634400: Space Systems Protection	4.001	7.841	8.118						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Conducted laboratory testing of candidate RF and laser countermeasures and validated multi-threat assessment tool. In FY 2009: Conduct demonstrations illustrating effects and meditation analysis. Identify technology transition opportunities and report findings to major commands. In FY 2010: Build and demonstrate additional subsystem performance in laboratory. Identify additional transition opportunities and prepare engineering models to assess performance.	0.961	1.883	2.199	
MAJOR THRUST: Develop passive satellite countermeasures and mitigation techniques for current and future threats to satellites. Note: In FY 2009, increased emphasis on space superiority technologies. In FY 2008: Selected the most promising detection and defensive technology and begin integration. Conducted demonstrations of systems integration and performance.	2.120	4.155	2.086	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 634400

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Conduct mitigation technology space demonstration and post flight analysis. In FY 2010: Demonstrate enhanced subsystems performance through laboratory testing. Identify transition opportunities and prepare engineering models to assess of performance.				
MAJOR THRUST: Develop visible and near-infrared laser protection technologies. In FY 2008: Developed selected protection techniques and coordinated space simulation testing of prospective protection technology. Qualified technology for application on space experiment for orbital demonstration. In FY 2009: Nominate "space qualified" technology and provide test unit to experimental satellite for integration. In FY 2010: Build candidate systems and conduct space qualification testing. Identify transition opportunities and prepare engineering models of performance.	0.920	1.803	2.038	
MAJOR THRUST: Develop active satellite local space awareness technologies and exploitation tools for satellite systems. Note: In FY 2010, emphasis is placed on space superiority technologies. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Conduct in-depth study of current capabilities and analysis of data available to satellite operators. Demonstrate active subsystems through laboratory testing. Prepare engineering performance models.	0.000	0.000	1.795	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 634400

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0602601F/ Spacecraft Technology.	0.000	0.000							Continuing	Continuing
PE 0603605F/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology					PROJECT NUMBER 635021	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635021: Space Systems Survivability	4.285	5.158	4.871						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Partially constructed joint agency coronagraph and heliospheric imager for solar hazard detection. Developed miniaturized space weather sensor engineering models. Initiated program to test and evaluate empirical flare prediction models based on synoptic data from Air Force and national observatory assets. In FY 2009: Complete development of miniaturized space weather sensor engineering models. Identify space test opportunity for miniaturized solar hazard sensors. Initiate development of a new standard model of the radiation belts. Co-operatively operate existing first generation heliospheric imagers in coordinated joint-agency campaign, exploiting unique three vantage point configuration. Develop and evaluate concepts for second-generation joint-agency heliospheric imager(s). In FY 2010: Continue development of new standard model of radiation belts to specify space hazards for spacecraft design. Design second-generation heliospheric imager as joint agency initiative.	3.244	3.940	3.940	
	0.336	0.397	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER 635021	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Conduct collaborative space and laboratory experiments and develop hardware and software tools to improve the survivability of spacecraft power, communications, navigation, and surveillance systems. Note: In FY 2010, the efforts in this thrust are combined with the following thrust. In FY 2008: Completed space plasma control experiment payload and began calibration and integration onto Air Force test satellite. Completed spacecraft environment effect tool suite to include dynamic space particle climatologies and forecast models. Released tool suite to DoD community. Completed radiation belt remediation payload calibration and complete integration onto Air Force test satellite. 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. In FY 2010: Not Applicable.					
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. Note: In FY 2010, this thrust is combined with the previous thrust. In FY 2008: Analyzed data from compact environment anomaly sensor data bases and continue anomaly resolution for space system design. Constructed hardware for space demonstration of the distributed anomaly resolution sensor. Integrated compact environment anomaly sensor for diagnosing severe radiation environment on Air Force test satellite. 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.		0.705	0.821	0.931	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 635021

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2010: Develop engineering model of micrometeoroid impact detector as a component of a spacecraft anomaly resolution system. Initiate development of radiation dosimeter, spacecraft charge sensors, and common satellite interface architecture for spacecraft protection.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0602601F/ Spacecraft Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology					PROJECT NUMBER 635083	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635083: Ballistic Missiles Technology	5.907	5.630	5.982						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Performed next generation missile navigation system engineering development, design, and ground test in relevant strategic environments, and evaluated design improvements against established performance goals. Conducted flight test demonstration planning. Initiated engineering system design verification and testing. 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. In FY 2010: Continue performance verification and integration of demonstration units. Begin advanced navigation instrument engineering model designs with common mission requirements for better accuracy, lower cost, increased robustness, and smaller size. Initiate planning for advanced guidance risk reduction ground and flight demonstrations.	2.953	2.816	2.991	
	2.954	2.814	2.991	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 635083

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop, integrate, and demonstrate advanced navigation technologies with new vehicle designs to provide robust, flexible, lower cost solutions for sustaining current strategic missile systems. In FY 2008: Completed 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. Evaluated performance navigation instrumentation and range safety devices with associated hardware and software interfaces in relevant dynamic and hostile environments. Validated system design refinements and initiated long-term plan for flight testing advanced navigational instrumentation and range safety devices with new vehicle designs. 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. In FY 2010: Complete hardware procurement and initiate the build and test of advanced navigation instrumentation and range safety devices with new vehicle design interfaces. Continue qualification testing of designs against validated system level interfaces. Begin dynamic and hostile environments analysis and testing of common advanced navigation instrumentation in support of strategic missile system development.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 635083

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601102F/ Defense Research Sciences.	0.000	0.000							Continuing	Continuing
PE 0602601F/ Space Technology.	0.000	0.000							Continuing	Continuing
PE 0603311F/ Ballistic Missile Technology.	0.000	0.000							Continuing	Continuing
PE 0603601F/ Conventional Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0603851F/ Intercontinental Ballistic Missile-Dem/Val.	0.000	0.000							Continuing	Continuing
PE 0604851F/ Intercontinental Ballistic Missile-EMD.	0.000	0.000							Continuing	Continuing
PE 0605860F/ Rocket System Launch Program-Space.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 635083

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology					PROJECT NUMBER 63682J	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
63682J: Spacecraft Vehicles	22.861	12.328	8.851						Continuing	Continuing

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and evaluate 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. In FY 2008: Completed fabrication of flight hardware for Thin-Film Radiation Exposure flight experiment. Completed ground portion of on-orbit prediction model for thin-film solar cells. Developed interconnect technologies for advanced multijunction solar cell structures. In FY 2009: Demonstrate greater than 14% efficient thin-film solar cells. Begin performance optimization of greater than 40% efficient solar cell concepts. In FY 2010: Demonstrate large area solar cells based on the inverted metamorphic structure. Develop integration schemes and module technology for inverted metamorphic solar cells. Begin environmental testing of inverted metamorphic solar cells.	2.307	2.197	2.637	
MAJOR THRUST: Develop technologies for long life, efficient, low-vibration, lightweight mechanical cryocoolers and integration components for space applications.	1.304	0.940	0.835	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER 63682J	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Completed design and developed a non moving parts compressor using proton biased membrane technology. Completed design and developed a low vibration conductance, cross gimbal 35 K cooling loop interface to support space tracking missions. Completed design and developed an improved thermal interface material doubling conductive transfer capacity in space cooling applications. Completed comprehensive study and began technology development of satellite cryogenic interface requirements and improved technologies to support space tracking applications. 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. In FY 2010: Continue support of missile launch detection thermal and cryogenic efforts. Continue study to determine the viability of infrared as an asset for space situational awareness missions. Continue development of a non-moving parts compressor using proton biased membrane technology. Continue development of a low vibration conductance, cross gimbal 35K 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.					
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 2009 and out, decreases due to realignment of responsive space technologies. In FY 2008: Developed symbiotic structural technologies for large deployable structural sensors and improved thermal management sensors. Performed flight-qualification tests of novel deployable structure architectures, cryogenic tanks, and launch vehicle structural components. Developed thermal management testbed.		5.122	2.950	2.805	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER 63682J	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Fly elastically-deployed, stored strain energy, deployable structural architectures including shape memory alloy reinforced hinges. Develop and test thermal management hardware. In FY 2010: Demonstrate symbiotic structural technologies for space applications through sub-scale laboratory testing or sub-orbital launch demonstration. Continue development of thermal management testbed for space structures developed for responsive space class satellites. Continue development of low-cost demonstration launch vehicle platforms. Initiate development of rapid fabrication processes to build tailored spacecraft panels in days, rather than weeks.					
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. Note: In FY 2009: Decrease in funding due to higher Air Force priorities. In FY 2008: Implemented estimation algorithm for improved local situational awareness using on existing on-orbit asset. In FY 2009: Begin implementation of advanced estimation algorithms for improved local situational awareness onto flight hardware prototype under development. In FY 2010: Finish development and integration of advanced estimation algorithms for improved local situational awareness. Begin development of guidance, navigation and control hardware for rapid integration and test.		2.340	1.852	2.574	
CONGRESSIONAL ADD: Large Automated Production of Expendable Launch Structure (LAPELS). In FY 2008: Conducted Congressionally-directed effort for LAPELS. In FY 2009: Not Applicable.		4.189	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER 63682J	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Microsatellite Serial Manufacturing. In FY 2008: Conducted Congressionally-directed effort for Microsatellite Serial Manufacturing. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.558	0.000	0.000	
CONGRESSIONAL ADD: Thin Film Amorphous Solar Arrays. In FY 2008: Conducted Congressionally-directed effort for Thin Film Amorphous Solar Arrays. In FY 2009: Conduct Congressionally-directed effort for Thin Film Amorphous Solar Arrays. In FY 2010: Not Applicable.		3.118	1.596	0.000	
CONGRESSIONAL ADD: Small Low-Cost Reconnaissance Spacecraft/Small Low-Cost Reconnaissance Spacecraft Components. In FY 2008: Conducted Congressionally-directed effort for Small Low-Cost Reconnaissance Spacecraft. In FY 2009: Conduct Congressionally-directed effort for Small Low-Cost Reconnaissance Spacecraft Components.		1.754	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER 63682J	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Space Situational Awareness. In FY 2008: Conducted Congressionally-directed effort for Space Situational Awareness. In FY 2009: Conduct Congressionally-directed effort for Space Situational Awareness. In FY 2010: Not Applicable.		1.169	1.197	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 63682J

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0602601F/ Spacecraft Technology.	0.000	0.000							Continuing	Continuing
PE 0603218C/ Research and Support.	0.000	0.000							Continuing	Continuing
PE 0603226E/ Experimental Evaluation of Major Innovative Technologies.	0.000	0.000							Continuing	Continuing
PE 0603500F/ Multi-Disciplinary Advanced Development Space Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 63682J

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603444F MAUI SPACE SURVEILLANCE SYSTEM					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	41.357	36.339	5.813						Continuing	Continuing
634868: Maui Space Surveillance System	41.357	36.339	5.813						Continuing	Continuing

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. 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.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	42.160	4.838	5.902	
Current BES/President's Budget	41.357	36.339	5.813	
Total Adjustments	-0.803	31.501	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.099		
Total Congressional Increases	0.000	31.600		
Total Reprogrammings	-0.068	0.000		
SBIR/STTR Transfer	-0.735	0.000		

Change Summary Explanation

Not Applicable.

Note: In FY 2009, Congress added $1.6 million for Flash Hyper-Dimensional Imaging System for Space Situational Awareness and Ballistic Missile Defense, $22.0 million for MSSS Operations and Research, and $8.0 million for the Panoramic Survey Telescope and Rapid Response System (Pan-STARRS).

C. Performance Metrics

Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603444F MAUI SPACE SURVEILLANCE SYSTEM					PROJECT NUMBER 634868	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
634868: Maui Space Surveillance System	41.357	36.339	5.813						Continuing	Continuing

A. Mission Description and Budget Item Justification

N/A

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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 $23.0 million in FY 2008 and $22.0 million in FY 2009. In FY 2008: Continued MSSS research, development, and operational contributions supporting various customers and experimenters. Continued refurbishing and upgrading MSSS and maintaining site safety and security in accordance with Air Force regulations. Continued development and implementation of self-sufficiency plan. Developed concepts for space situational awareness, space system characterization, and active tracking. Continued development of a state-of-the-art, high-performance sodium beacon adaptive optics system. Provided health/status, identification, and anomaly resolution for selected satellites using ultra-precise astrodynamics techniques and electro-optic characterization. In FY 2009: Continue MSSS infrastructure contributions in research, development, and operations that support 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. Continue development and implementation of self-sufficiency plan. In FY 2010: Continue MSSS infrastructure contributions in research, development, and operations that support various customers and space situational awareness research and demonstrations. Continue refurbishing and upgrading MSSS to accommodate those missions and maintaining requirements for safety and security in accordance with Air Force regulations. Continue development and implementation of self-sufficiency plan.	27.495	26.765	5.813	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603444F MAUI SPACE SURVEILLANCE SYSTEM			PROJECT NUMBER 634868	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Panoramic Survey Telescope And Rapid Response System (Pan-STARRS). In FY 2008: Continued transition of Pan-STARRS telescope on Maui into routine use for sky surveys. Completed utility demonstration. Initiated four-telescope system design and development based on lessons learned from Maui installation/operations. In FY 2009: Pan-STARRS telescope on Maui will be in routine use for sky surveys. Begin second single telescope system procurement and construction based on lessons learned from first telescope. In FY 2010: Not Applicable.		8.785	7.978	0.000	
CONGRESSIONAL ADD: High Accuracy Network Determination System (HANDS). In FY 2008: Support research activities and data collection to improve persistent space situational awareness capabilities. Continue efforts to obtain foreign operating rights in order to deploy a small telescope to Australia. Continue development of improved small autonomous telescope with increased data collection capabilities. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		5.077	0.000	0.000	
CONGRESSIONAL ADD: Flash Hyper-Dimensional Imaging System for Space Situational Awareness and Ballistic Missile Defense. In FY 2008: Not Applicable.		0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603444F MAUI SPACE SURVEILLANCE SYSTEM	PROJECT NUMBER 634868

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Provide hyperspectral imaging for missile intercepts and SSA applications. Determine temperatures on missile intercept fireballs and do debris tracking. Provide hyperspectral information to aid in identifying non-imaging space objects. In FY 2010: Not Applicable.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603444F MAUI SPACE SURVEILLANCE SYSTEM	PROJECT NUMBER 634868

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602605F/ Directed Energy Technology.	0.000	0.000							Continuing	Continuing
PE 0603605F/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0601108F/ High Energy Laser Research Initiatives.	0.000	0.000							Continuing	Continuing
PE 0602890F/ High Energy Laser Research.	0.000	0.000							Continuing	Continuing
PE 0603924F/ High Energy Laser Advanced Technology Program.	0.000	0.000							Continuing	Continuing
PE 0603883C/ Ballistic Missile Defense Boost Phase Segment.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603444F MAUI SPACE SURVEILLANCE SYSTEM	PROJECT NUMBER 634868

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603456F Human Effectiveness Adv Tech Dev					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	0.000	24.565						Continuing	Continuing
635323: Directed Energy Bioeffects Parameters	0.000	0.000	1.703						Continuing	Continuing
635324: Human Dynamics and Terrain Demonstration	0.000	0.000	6.259						Continuing	Continuing
635325: Mission Effective Performance	0.000	0.000	4.703						Continuing	Continuing
635326: Performance Enhancement Demonstration	0.000	0.000	4.556						Continuing	Continuing
635327: Warfighter Interfaces	0.000	0.000	7.344						Continuing	Continuing

Note

Note: In FY 2010, Directed Energy Bioeffects Parameters efforts will move from PE 0603231F, Project 5020 to PE 0603456F, Project 5323; Human Dynamics and Terrain Demonstration efforts will move from PE 0603231F, Project 2830 to PE 0603456F, Project 5324; Mission Effective Performance efforts will move from PE 0603231F, Project 4924 to PE 0603456F, Project 5325; Performance Enhancement Demonstration efforts will move from PE 0603231F, Project 2830 and Project 5020 to PE 0603456F, Project 5326; and Warfighter Interfaces efforts will move from PE 0603231F, Project 2830 to PE 0603456F, Project 5327 to better align efforts.

A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to enhance human performance and effectiveness in the aerospace force. State-of-the-science advances are made in warfighter training, warfighter system interfaces, directed energy bioeffects, deployment and sustainment of warfighters in extreme environments, and understanding and shaping adversarial behavior. The Mission Effective Performance project develops, demonstrates, and transitions advanced training, simulation, mission rehearsal, and other performance-aiding methods and technologies to enhance warfighter readiness. The Warfighter Interfaces project develops, demonstrates, and transitions technologies to revolutionize the way human operators synergistically use Air Force systems, including autonomous machines and adaptive teams of humans and machines. The Directed Energy Bioeffects Parameters project develops, demonstrates, and transitions technologies to predict, evaluate, and mitigate the effects of directed energy on personnel and mission performance, and exploits the offensive capabilities of directed energy systems. The Performance Enhancement Demonstration project develops, demonstrates, and transitions technologies to increase survivability and performance of personnel

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during military operations. The Human Dynamics and Terrain Demonstration project develops, demonstrates, and transitions technologies to anticipate and influence adversarial behavior within the air, space, and cyber domains. 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.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	0.000	0.000	0.000	
Current BES/President's Budget	0.000	0.000	24.565	
Total Adjustments	0.000	0.000	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	0.000		
Total Congressional Increases	0.000	0.000		
Total Reprogrammings	0.000	0.000		
SBIR/STTR Transfer	0.000	0.000		

Change Summary Explanation

Not Applicable.

C. Performance Metrics

Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635323: Directed Energy Bioeffects Parameters	0.000	0.000	1.703						Continuing	Continuing

Note

Note: In FY 2010, Directed Energy Bioeffects Parameters efforts will move from PE 0603231F, Project 5020 to PE 0603456F, Project 5323 to better align efforts.

A. Mission Description and Budget Item Justification

This project develops, demonstrates, and transitions technologies to predict, evaluate, and mitigate the effects of directed energy on personnel and mission performance, and exploits the offensive capabilities of directed energy systems. This project also develops the human-components of the guidelines for testing, deployment, and protection from high power microwave and high-energy laser systems and uses this information to enhance the effectiveness of these weapon systems in air, space, and cyber operations. The optical radiation bioeffects research develops and demonstrates technologies that counter optical threats, while exploiting optical systems for non-lethal applications. Radio frequency radiation (RFR) bioeffects research develops, demonstrates, and transitions technologies to the warfighters. Biobehavioral systems efforts focus on the design and characterization of scalable non-lethal directed energy and novel effects weapons, including quantification of physiological and psychological effectiveness and risks associated with these weapons.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and demonstrate protective technologies for aircrew and ground personnel to provide protection against directed energy threats. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Complete validation and verification of human systems integration tool for directed energy protective equipment (optical radiation only). Continue assessment of radio frequency radiation personnel protection technologies. Begin monitoring optical radiation skin protection technologies.	0.000	0.000	0.816	
	0.000	0.000	0.887	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and demonstrate technologies to assess bioeffects and collateral hazards from directed energy systems. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Combine angular-dependent and individual/crowd behavior models as function of directed energy parameters. Integrate target effects across directed energy spectrum into collateral damage tool development. Conduct field validation studies of model predictions. Develop conceptual design for mission planning tools.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0603231F/ Crew Systems and Personnel Protection Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635324: Human Dynamics and Terrain Demonstration	0.000	0.000	6.259						Continuing	Continuing

Note

Note: In FY 2010, Human Dynamics and Terrain Demonstration efforts will move from PE 0603231F, Project 2830 to PE 0603456F, Project 5324 to better align efforts.

A. Mission Description and Budget Item Justification

This project develops, demonstrates, and transitions technologies to anticipate and influence adversarial behavior within the air, space, and cyber domains. These technologies will enhance Air Force capabilities in intelligence, surveillance, and reconnaissance (ISR), layered sensing, decision aids for computer network attack/ defense/support, cyber force development and training, anticipatory command, control, and intelligence (C2I), measures of effectiveness for psychological operations, cross-cultural communication, and human-centric exploitation of measurement and signatures intelligence.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop, mature, and demonstrate technology to provide mission-essential capabilities for AF cyber operator performance enhancement. Demonstrate and transition human-centric decision-support tools and models for increased cyber operator situational awareness. Demonstrate quantitative measures of effectiveness for candidate cyber operator improvement capabilities. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop technologies to enhance cyber operator situational awareness capabilities. Develop advanced cyber mission/campaign planning tools that optimize blue force readiness and operational effectiveness. Develop, integrate, and assess advanced cyber mission/campaign planning tools that facilitate the operator's ability to anticipate and influence an adversary's behavior.	0.000	0.000	2.197	
	0.000	0.000	0.994	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: The ISR technology portfolio is focused on human-centered design processes and operational tools that optimize information flows between ISR analysts, assessors, collection managers, and warfighters operating in a distributed collaborative, multi-source mission planning environment. Enhance current and planned network-centric and effects-based operations with advanced technology tools that produce faster, more effective ISR information for decision makers. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop and demonstrate automated tools and techniques designed to decrease an intelligence analyst's data overload condition and improve productivity. Concentrate technology development in the areas of ISR processes, ISR mission planning, and tool integration utilizing net-centric automated services to increase ISR enterprise capabilities, effectiveness, and quality, while reducing complexity, cost, and intelligence production cycle times. Demonstrate and transition technologies for ISR dynamic planning, geospatial intelligence tools, and multi-INT information operations tools used in AF ISR weapons systems. Develop and assess the effectiveness of anticipatory approaches to enhance command, control, and intelligence.					
MAJOR THRUST: Develop and demonstrate anticipatory C2I 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. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		0.000	0.000	1.105	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Integrate decision-aiding tools into identified technology demonstration programs. Evaluate the methodologies developed to quantifiably measure the effectiveness of the commander's predictive environment decision aids and simulation tools. Refine tools with emphasis on intelligence analysis and the anticipation elements. Evaluate the expanded operational benefits and utility of the decision aid tools and simulation in field exercises.				
MAJOR THRUST: Identify, integrate, demonstrate, and transition technology that optimizes human operator performance within AF influence operations. Refine techniques to anticipate and influence an adversary's behavior. Demonstrate adversarial modeling techniques used to gauge adversarial intent and probabilities/ methods of attack. Develop and mature automated foreign speech translation tools to aid AF information/ influence operations warfighters. Develop models demonstrating quantitative measures of effectiveness of advanced influence operations capabilities. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Identify, integrate, demonstrate, and transition technology that optimizes human operator performance within AF influence operations. Illustrate adversarial cultural modeling techniques used to gauge adversarial threats. Mature and transition research into influence operations human performance training effectiveness, mission rehearsal, simulations, and combat readiness. Mature quantitative measures of effectiveness for psychological operations (PSYOP) and selected influence operations capabilities. Develop and demonstrate next-generation information operations and cyber influence capabilities yielding non-kinetic warfighting options. Demonstrate and transition advanced speech-to-speech translation tools which support automated, cross-cultural communications.	0.000	0.000	1.963	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0603231F/ Crew Systems and Personnel Protection Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635325: Mission Effective Performance	0.000	0.000	4.703						Continuing	Continuing

Note

Note: In FY 2010, Mission Effective Performance efforts will move from PE 0603231F, Project 4924 to PE 0603456F, Project 5325 to better align efforts.

A. Mission Description and Budget Item Justification

This project develops, demonstrates, and transitions advanced training, simulation, mission rehearsal, and other performance-aiding methods and technologies to enhance warfighter readiness. This project also develops advanced methods and technologies to enable interactive live, virtual, and constructive (LVC) environments for performance-aiding methods and technologies. Activities include development of computer-generated entities to support training, simulation, and mission rehearsal; integrated high-fidelity weapon-systems training technologies for air, space, and cyber; tailored immersive simulation environments for Airmen at the tactical and operational levels; robust performance assessment and feedback tools; and maturation of game-based technologies for effective and efficient training. These methods and technologies facilitate the development of mission-essential competencies.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Advance aerospace and organizational behavior models for integrated warfighter training and rehearsal. These computer-generated models will add realistic operations, command and control, force protection, and air base defense warfighters. Technologies will increase training effectiveness and efficiency, and decrease time-to-mission qualification. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Evaluate and validate learning and mission performance impacts associated with common tools for mission planning, briefing, and after action review. Identify specific methods and tools of relevance within and across mission contexts and levels of decision making (e.g., tactical, operational, and strategic). Validate immersive training alternative environments for coalition training for close air support and air-to-ground coordination. Conduct schoolhouse and field training, rehearsal, and exercise evaluations and demonstrations	0.000	0.000	2.349	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
in LVC contexts for close air support and command and control. Demonstrate integration of distributed air and space operations center (AOC) teams with tactical LVC operations for kill-chain training and operations. Field deployable distributed mission operations (DMO) training exemplars and conduct mission impact evaluations on their integration into routine operations training events. Complete development for deployable trainers and mission planning and after action review toolsets and update field deployed systems for further evaluation and training assessment.					
MAJOR THRUST: Develop and demonstrate a high-fidelity DMO training and rehearsal capability for operators in an 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 LVC training networks for future threat systems/capabilities and advanced sensor platforms and weapons systems. These technologies provide AF and coalition warfighters with more realistic EW mission training and rehearsal environments that accurately represent 21st century threats, thereby increasing operational readiness and capability. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop the integrated strategy and plans division trainer based on competency-based training requirements and optimum mission rehearsal strategies. Develop individual interfaces between component simulations and AOC equipment systems. Begin to code, integrate, and test the execution management capabilities for the simulation set. Begin development of a DMO and C2ISR common database generation system and live EW range integration into DMO. Demonstrate an on-range live fly of LVC EW training with live emitters/platforms.		0.000	0.000	2.354	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0603231F/ Crew Systems and Personnel Protection Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635326: Performance Enhancement Demonstration	0.000	0.000	4.556						Continuing	Continuing

Note

Note: In FY 2010, Performance Enhancement Demonstration efforts will move from PE 0603231F, Project 2830 and Project 5020 to PE 0603456F, Project 5326 to better align efforts.

A. Mission Description and Budget Item Justification

This project develops, demonstrates, and transitions technologies to increase survivability and performance of personnel during military operations. Bioscience efforts develop advanced biotechnology, nanotechnology, and neuroscience solutions for the protection and enhanced effectiveness of battlefield airmen. Counterproliferation efforts develop biotechnology and bio-taggants to advance the ability to detect, identify, monitor, and neutralize biological threat agents. The counterproliferation effort also demonstrates and transitions modeling and simulation techniques for operational assessment of pre- and post-bio-agent attack. Biobehavioral and biomechanics focus areas develop aircrew support technologies that enhance warfighter protection and improve performance during long-duration missions. The biomechanics focus area also develops technology to rapidly integrate multi-sensor data with automated dynamic human modeling to anticipate and identify human adversarial threats.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: In the counterproliferation area, 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. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Optimize the selected bio-taggant technologies and begin the development of platforms to employ the bio-taggants. Optimize the insertion/distribution of bio-taggants in target areas. Evaluate taggant technologies in simulated operational environments. Initiate research to develop capabilities to track biological warfare agents inside buildings and vehicles.	0.000	0.000	1.709	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop and demonstrate technologies for improved force protection, maintenance of peak warfighter performance in known toxic environments, and identification of difficult-to-detect enemy threats. Develop technologies to rapidly integrate multi-sensor data with automated dynamic human modeling to anticipate, find, fix, track, and identify human threats. Develop model-based threat awareness, visualization, and risk assessment technologies that include human adversarial intent. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop methods to identify key human threat indicators to reduce bandwidth requirements and enable real-time threat assessment from the air. Develop enhanced anthropometric visualization techniques that integrate heterogeneous sensor data of potential adversaries.		0.000	0.000	2.847	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0603231F/ Crew Systems and Personnel Protection Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635327: Warfighter Interfaces	0.000	0.000	7.344						Continuing	Continuing

Note

Note: In FY 2010, Warfighter Interfaces efforts will move from PE 0603231F, Project 2830 to PE 0603456F, Project 5327 to better align efforts.

A. Mission Description and Budget Item Justification

This project develops, demonstrates, and transitions technologies to revolutionize the way human operators optimize the capabilities of Air Force systems, including autonomous machines and adaptive teams of humans and machines. Improvements in the presentation of operational information to the community of users, from the system operator to the commander, must be developed in step with advancements in the acquisition, storage, and retrieval of information. This project provides the advances in understanding of human cognitive abilities, as well as the utilization of human interfaces, multi-sensory fusion, high-resolution image displays, and three-dimensional audio to customize communications and enhance shared understanding across a diverse user community in air, space, and cyber for maximum situational awareness.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and demonstrate technologies in a collaborative interface infrastructure to facilitate team building, sensemaking, and workflow in a globally distributed, net-centric command and control (C2) environment. Technologies address uncertainty, sharing difficulty, temporal arrangement, and integrated work coupling to ensure that C2 warfighters can effectively collaborate in distributed operations as a net-enabled "teamspace." In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Analyze the hardware and software trade-space options for a future C2 collaborative interface environment. Begin concept development of sensemaking technologies and collaborative decision support tools for the resulting net-centric C2 environment infrastructure.	0.000	0.000	0.910	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and demonstrate technologies to interface between ground-based combat controllers and multiple machine components through unified visual and auditory displays for battlefield airmen. 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. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop integrated multisensory interfaces for ground-based combat controllers. Develop and demonstrate advanced cabling and wireless technologies to improve operator mobility, decrease system setup time, and reduce the probability of user errors or system malfunctions. Demonstrate integrated human-centered concepts for enhanced portability, maintainability, and usability. Refine audio and visual interfaces to enhance operator survivability, improve communication effectiveness, and allow effective use of wearable computers without impairing the mobility of dismounted combat controllers.	0.000	0.000	2.720	
MAJOR THRUST: Develop and demonstrate supervisory-level interfaces between ground controllers and multiple, highly autonomous unmanned aerial systems (UAS). Employ real-time wargaming simulations and field tests to quantify the decision-making benefits from advanced control/display portrayal concepts that optimize net-centric information flow to system operators. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop warfighter interface control station technologies permitting the effective conduct of cooperative dynamic reconnaissance, surveillance, and target acquisition missions either by a single warfighter	0.000	0.000	1.392	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
or by a two-person crew in the next-generation supervisory control station. Integrate advanced mission and sensor management controls, displays, and decision aids with multi-UAS cooperative control automation for demonstration of the next-generation supervisory control station. Begin to demonstrate and assess system performance and mission effectiveness in high-fidelity virtual simulation and flight test environments.					
MAJOR THRUST: Develop and demonstrate advanced job performance aiding technologies, emphasizing human interaction with complex planning algorithms. Job-aiding technologies will provide planners with automated access to a manageable amount of multi-source information, minimize information overload, and support faster and more accurate decision-making. These technologies will allow the planners and automation to develop and optimize a set of plans and best course of action. Note: In FY 2010, this effort is broken out from the first major thrust to separate distinct technology areas. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Begin to develop a visual interface concept that planners may use to visualize the primary constraints within capacity-based planning. Include alternative planning algorithms that exploit cognitive engineering and work-centered design principles. Outline a program plan featuring interactive simulations as a way to optimize resource allocation in complex time-sensitive deployments.		0.000	0.000	0.500	
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.		0.000	0.000	1.822	

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APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603456F Human Effectiveness Adv Tech Dev	PROJECT NUMBER 635327

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Begin analysis and refine analytic methods and techniques to support unified action for large, cross-organizational C2 teams and teams-of-teams. Begin concept development of an extensible work-aiding framework that integrates future and current work aids into a coherently unified framework that affords efficient and effective action of large distributed and semi-independent teams and individuals.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Effectiveness Applied Research.	0.000	0.000							Continuing	Continuing
PE 0603231F/ Crew Systems and Personnel Protection Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603456F Human Effectiveness Adv Tech Dev	PROJECT NUMBER 635327

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603601F Conventional Weapons Technology					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	18.698	17.166	14.356						Continuing	Continuing
63670A: Conventional Weapons Development	18.698	17.166	14.356						Continuing	Continuing

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. 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. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	18.379	11.813	17.942	
Current BES/President's Budget	18.698	17.166	14.356	
Total Adjustments	0.319	5.353	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.047		
Total Congressional Increases	0.000	7.400		
Total Reprogrammings	0.779	-2.000		
SBIR/STTR Transfer	-0.460	0.000		

Change Summary Explanation

In FY 2009, Congress added $2.4 million for Energetic Device Quality and Reliability Improvements Using Computer-Aided Process Control and Congress added $3.0 million for Integrated Targeting Devices.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603601F Conventional Weapons Technology					PROJECT NUMBER 63670A	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
63670A: Conventional Weapons Development	18.698	17.166	14.356						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops, demonstrates, and integrates ordnance and affordable, autonomous, and adverse weather resistant guidance technologies for enhancing the effectiveness of air-launched conventional weapons delivered from manned and unmanned aerospace vehicles. The project develops conventional ordnance including warheads, fuzes, explosives, carriage and release, munition integration technologies, terminal seekers, midcourse navigation sensors for stand off delivery weapons, and target detection and identification processing algorithms for reducing target location error to improve target kill probability. This project improves the capability for conventional munitions supporting an Air Expeditionary Force.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Developed and tested hard target influence fuze. Developed an active imaging target device that can provide warhead aimpoint selection for mass focused warheads. In FY 2009: Continue development of an active imaging target device that can provide warhead aimpoint selection for mass focused warheads. In FY 2010: Complete development of an active imaging target device that can provide warhead aimpoint selection for mass focused warheads.	3.399	2.758	3.454	
MAJOR THRUST: Develop and demonstrate conventional munition subsystem and platform integration technologies to include innovative air-delivered munition carriage and release equipment, miniature weapon release concepts, and reduced airframe size providing the capability to safely carry, launch, and communicate	0.671	0.267	4.717	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603601F Conventional Weapons Technology			PROJECT NUMBER 63670A	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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. In FY 2008: Developed small powered short-range precision-guided submunition capable of attacking multiple moving targets. In FY 2009: 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 air defenses. In FY 2010: Continue development of a small powered short-range precision-guided submunition capable of attacking multiple moving targets. Continue 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 air defenses. Begin developing a conventional ordnance package consisting of a case, fuze, fuzewell, and explosive fill capable of penetrating high performance concrete at conventional velocities.					
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. (NOTE: FY 2009 is the last year for ordnance and air-to-air missile demonstration efforts.) In FY 2008: Developed 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. Developed a multi-mode warhead package designed for precision guided submunitions. In FY 2009: Demonstrate 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.		6.949	3.269	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603601F Conventional Weapons Technology			PROJECT NUMBER 63670A	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: All counter air warhead efforts are concluded. No funds are allocated this year; awaiting 6.2 developed warhead efforts.					
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. In FY 2008: Continued 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. Developed a multi-mode radar seeker capable of engaging both moving and stationary targets in adverse weather. 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 technologies. Flight test a multi-mode radar seeker capable of engaging both moving and stationary targets in adverse weather. In FY 2010: Complete demonstration of a low cost laser detection ordnance seeker to increase data rates. Investigate the design details for a low cost multispectral seeker to provide autonomous, all weather operation.		6.130	5.487	3.460	
MAJOR THRUST: Develop and demonstrate advanced conventional armament navigation and control technologies to increase armament navigation accuracy, improve stand off range, and enhance weapons control and operation in electronic jamming environments. (NOTE: In FY 2010, technologies developed under weapon data effort will be used to support guidance/control program which has coordinated submunition attack from an unmanned munition platform.) In FY 2008: Not Applicable.		0.000	0.000	2.725	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603601F Conventional Weapons Technology			PROJECT NUMBER 63670A	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Not Applicable. In FY 2010: Develop a small guided sub-munition to attack multiple moving targets.					
CONGRESSIONAL ADD: Moving Target Strike. In FY 2008: Conducted Congressionally-directed effort for Moving Target Strike. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.549	0.000	0.000	
CONGRESSIONAL ADD: Energetic Device Quality and Reliability Improvements Using Computer Aided Process Control. In FY 2008: Not Applicable. In FY 2009 : Conduct Congressionally-directed effort for Energetic Device Quality and Reliability Improvements Using Computer-Aided Process Control. In FY 2010: Not Applicable.		0.000	2.393	0.000	
CONGRESSIONAL ADD: Integrated Targeting Devices. In FY 2008: Not Applicable.		0.000	2.992	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603601F Conventional Weapons Technology	PROJECT NUMBER 63670A

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Conduct Congressionally-directed effort for Integrated Targeting Devices. In FY 2010: Not Applicable.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602602F/ Conventional Munitions.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	78.556	56.283	30.056						Continuing	Continuing
6311SP: Advanced Optics and Laser Space Tech	38.079	16.530	0.000						Continuing	Continuing
633150: Advanced Optics Technology	11.275	10.970	0.000						Continuing	Continuing
633151: Lasers and Imaging Development and Integration	19.166	20.513	16.624						Continuing	Continuing
633152: High Power Microwave Development and Integration	10.036	8.270	13.432						Continuing	Continuing

A. Mission Description and Budget Item Justification

This program provides for the development and demonstration of advanced directed energy and optical concepts. In electric lasers, compact, reliable, relatively high power, cost-effective electric laser devices are demonstrated. High power chemical laser enhancements are also developed. Optical imaging/beam control components/techniques are demonstrated. In high power microwaves (HPMs), technologies such as narrowband and wideband devices and antennas are demonstrated. 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, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603605F Advanced Weapons Technology

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	74.383	44.507	48.530	
Current BES/President's Budget	78.556	56.283	30.056	
Total Adjustments	4.173	11.776	0.000	
Congressional Program Reductions	0.000	-0.031		
Congressional Rescissions	0.000	-0.153		
Total Congressional Increases	0.000	11.960		
Total Reprogrammings	5.782	0.000		
SBIR/STTR Transfer	-1.609	0.000		

Change Summary Explanation

Funding was increased in FY 2009 for additional demonstrations leading to an earlier transition of tactical directed energy weapon technologies. In FY 2010 several electric laser, relay mirror, and space situational awareness efforts have been moved from this PE into PE 0602605F, Directed Energy Technology, to better reflect the actual technology readiness level of the efforts.

Note: In FY 2009, Congress added $1.2 million for Compound Zoom for Airborne Reconnaissance (CZAR), $0.96 million of Advanced Fiber Lasers Systems and Components, $7.0 million for Applications of LIDAR to Vehicles with Analysis, and $2.8 million for Real-time Optical Surveillance Applications.

C. Performance Metrics
Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology					PROJECT NUMBER 6311SP	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
6311SP: Advanced Optics and Laser Space Tech	38.079	16.530	0.000						Continuing	Continuing

Note

Note: In FY 2010, funds from this Project are being moved to Project 3151, Lasers and Imaging Development and Integration, in this PE or Project 4866, Lasers and Imaging Technology, in PE 0602605F, Directed Energy Technology, to better align efforts depending on the technology readiness level of the effort.

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. Starting in FY 2010 this project will be combined with other projects to better integrate the directed energy efforts.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. This includes atmospheric compensation/beam control experiments using large aperture telescopes, for space situational awareness applications such as high-resolution satellite imaging, detection and characterization of small/dim space objects, and high accuracy space object tracking. Note: In FY 2010, this thrust has been moved to Project 4866, Laser and Imaging Technology, in PE 0602605F, Directed Energy Technology, to better reflect the technology readiness level of these efforts. In FY 2008: Continued design and began subsystem integration of high efficiency adaptive optics system for compensated imaging and detection of very dim space objects at visible and near infrared wavelengths. Performed laboratory tests to validate the performance of lightweight mirrors. In FY 2009: Integrate high efficiency adaptive optics system on large aperture high resolution telescope. Perform system tests and prepare for demonstrations of high resolution compensated imaging and detection of very dim space objects at visible and infrared wavelengths. Conclude phased array imaging experiments. In FY 2010: Not Applicable.	5.818	4.365	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology			PROJECT NUMBER 6311SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop and demonstrate advanced optical beam control technologies for laser propagation through severe and/or extended atmospheric turbulence. Note: In FY 2010, this thrust has been moved to Project 3151, Lasers and Imaging Development and Integration, to better align efforts. In FY 2008: Continued design of advanced ground diagnostic system for characterization of laser propagation through stressing atmospheric turbulence. Performed laboratory characterization on components for sensing and wavefront control technologies. In FY 2009: Complete design of advanced ground diagnostic system to characterize laser propagation through atmospheric turbulence in a variety of atmospheric conditions. In FY 2010: Not Applicable.		15.349	12.165	0.000	
CONGRESSIONAL ADD: Space Situational Awareness. In FY 2008: Developed, integrated, and tested component and system level technologies to advance space situational awareness. Improved the performance of current collection, analysis, fusion, and dissemination capabilities such as implementing sodium guidestar atmospheric compensation to the Maui Space Surveillance System. Developed technologies for satellite modeling and assessment. Developed tools for analysis, modeling, and simulation. Developed and demonstrated resolved and non-resolved satellite imaging concepts. Developed and demonstrated passive and active imaging concepts. Developed and demonstrated space-object identification techniques. Developed image processing algorithms. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		14.580	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology			PROJECT NUMBER 6311SP	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
CONGRESSIONAL ADD: Satellite Active Imaging National Testbed (formerly GEO Light Imaging National Testbed (GLINT)). In FY 2008: Developed end-to-end simulation code for the compensated Fourier telescopy method incorporating a new reconstruction code. Completed a lab demonstration of the compensated Fourier telescopy method simulating all relevant parameters. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		2.332	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology	PROJECT NUMBER 6311SP

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0602605F/ Directed Energy Technology	0.000	0.000							Continuing	Continuing
PE 0603444F/ Maui Space Surveillance System	0.000	0.000							Continuing	Continuing
PE 0601108F/ High Energy Laser Research Initiatives.	0.000	0.000							Continuing	Continuing
PE 0602890F/ High Energy Laser Research.	0.000	0.000							Continuing	Continuing
PE 0603924F/ High Energy Laser Advanced Technology Program.	0.000	0.000							Continuing	Continuing
PE 0602120A/ Sensors and Electronic Survivability.	0.000	0.000							Continuing	Continuing
PE 0602307A/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0602624A/ Weapons and Munitions Technology.	0.000	0.000							Continuing	Continuing
PE 0603004A/ Weapons and Munitions Advanced Technology.	0.000	0.000							Continuing	Continuing
PE 0602114N/ Power Projection Applied Research.	0.000	0.000							Continuing	Continuing
PE 0602702E/ Tactical Technology.	0.000	0.000							Continuing	Continuing
	0.000	0.000							Continuing	Continuing

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification			DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)			R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology		PROJECT NUMBER 6311SP
PE 0603175C/ Ballistic Missile Defense Technology.					
PE 0603883C/ Ballistic Missile Defense Boost Phase Segment	0.000	0.000		Continuing	Continuing
PE 0602651M/ Joint Non-Lethal Weapons Applied Research.	0.000	0.000		Continuing	Continuing
PE 0603651M/ Joint Non-Lethal Weapons Technology Development.	0.000	0.000		Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000		Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology					PROJECT NUMBER 633150	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
633150: Advanced Optics Technology	11.275	10.970	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops advanced optical technologies for various strategic and tactical beam control applications.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: Applications of LIDAR to Vehicles with Analysis (ALVA). In FY 2008: ALVA consists of two efforts: Standoff Intelligence Designator (SID) and Hi-Class. SID: Completed testing of active nighttime imagers and prepared to transition technology to customers. Developed smaller, lighter laser imagers for new customers. Evaluated potential for using continuous-wave laser sensors for different applications. Hi-Class: Continued integration and began testing of the three-dimensional capability for imaging/detection of small/dim space objects. Continued efforts to integrate a hyperspectral imager into the Hi-Class system. In FY 2009: ALVA consists of two efforts: Standoff Intelligence Designator (SID) and Hi-Class. SID: Develop airborne night-time imaging for counter improvised explosive devices (IEDs) and operational intel and targeting users such as US Marine Corps, Air Combat Command, and US Special Operations Command. Support transition of militarily useful lasers for nighttime video, by flight testing, integration of state-of-the-art sensors into real-world air frames, proof of concept for communications networks, perform evaluation studies, and participate in war games and exercises. Hi-Class: Integrate laser ranging detector into active tracking system. Continue research and data collection for three dimensional imaging of space objects and ranging applications. In FY 2010: Not Applicable.	8.165	6.981	0.000	
CONGRESSIONAL ADD: Real-time Optical Surveillance Applications (ROSA).	1.555	2.792	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology			PROJECT NUMBER 633150	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Leveraged previously developed models to examine three dimensional imaging capabilities of time-resolved photon counter for improvements in pose estimation. Conducted modeling and simulation studies to push current capabilities in pose estimation and change detection with optical sensors. Pursued artificial intelligence concept in automation of telescope networks for space situational awareness mission. In FY 2009: Continue development of models to study potential of ultra sensitive time-resolved photon counter for covert active imaging. Continue modeling and simulation studies to push current capabilities in pose estimation and change detection with optical sensors. Explore artificial intelligence concept for responsive automation of telescope networks for space situational awareness mission. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Compound Zoom for Airborne Reconnaissance (CZAR). In FY 2008: Developed requirements and preliminary designs for hardware and software modifications to adapt and demonstrate a commercial high quality compact compound zoom lens for an Air Force application. Conducted a study to evaluate multiple sensors (cameras). Used modeling and simulation to develop robust stabilization control. In FY 2009: Complete critical design review and fabricate optical system. Integrate optical system and conduct laboratory testing. Fabricate and integrate stabilization control system. Develop system software and system test plan. In FY 2010: Not Applicable.		1.555	1.197	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology	PROJECT NUMBER 633150

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603444F/ Maui Space Surveillance Systems.	0.000	0.000							Continuing	Continuing
PE 0602605F/ Directed Energy Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology					PROJECT NUMBER 633151	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
633151: Lasers and Imaging Development and Integration	19.166	20.513	16.624						Continuing	Continuing

Note

Note: In FY 2010, some of the efforts from Project 11SP, Advanced Optics and Laser Space Technology, are being moved to this Project to better align efforts. Also in FY 2010, some of the electric laser, relay mirror, and space situational awareness efforts in this project have been moved into PE 0602605F, Directed Energy Technology, to better reflect the technology readiness level of the efforts.

A. Mission Description and Budget Item Justification

This project provides for the development, integration, demonstration, and detailed assessment of imaging and laser and beam control technologies needed for aircraft self-protection, force protection, force application, precision engagement, space situational awareness, 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, imaging, and laser beam control components to compensate and propagate laser radiation through the atmosphere and/or to detect and characterize space objects. Perform laser system concept assessments to include vulnerability assessments and target effect testing.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop, integrate, and demonstrate electric, chemical, gas, and hybrid laser technologies for scalable, high energy laser devices for future insertion into airborne tactical and strategic applications and ground-based laser system concepts. In FY 2008: Continued development of electric lasers for a wide set of applications including tactical weapons, self-defense, and space situational awareness (e.g. active tracking and imaging) with a goal of exceeding the thresholds for system power, beam quality, and run time capabilities. These technologies will reduce laser size and weight, as well as increase efficiency, affordability, reliability, maintainability, supportability, operational environmental acceptability, and ruggedness. Completed development of a 15 kilowatt solid state laser to be coupled to an existing beam control subsystem for an integrated laboratory testbed.	5.002	5.973	2.726	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology			PROJECT NUMBER 633151	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Continue to develop electric lasers for a variety of applications such as aircraft self-protection. Continue to focus on reducing size and weight, as well as increasing efficiency, affordability, reliability, maintainability, supportability, operational environmental acceptability, and ruggedness. Complete integration of the 15 kilowatt solid state laser with an existing beam control subsystem for an integrated laboratory testbed. Prepare for integration of appropriate laser technologies for a large aircraft demonstration of electric laser-based precision engagements. In FY 2010: Design, develop, and test aircraft self-protection components including electric laser source and beam director capable of countering next generation missile threats with seekers based on imaging (focal plane array) technology. Develop appropriate technologies to allow the use of a solid state laser in a demonstration of a potential weapon system capability on a large aircraft.					
MAJOR THRUST: Develop, integrate, and demonstrate advanced optical and imaging technologies for advanced systems concepts. Develop and demonstrate integrated tactical laser and beam control technologies. Technologies include optical components, optical coatings, advanced beam control, atmospheric compensation, and pointing and tracking. Analyze system concepts and perform critical experiments with integrated laser and beam control technologies. Note: Funding was increased in FY 2009 for additional integrated demonstrations leading to an earlier transition of tactical airborne laser and beam control technologies. Based on the technology readiness level of the tactical relay mirror technology, in FY 2010 this effort was moved into PE 0602605F, Directed Energy Technology. In FY 2008: Demonstrated advanced tactical beam control hardware components in the laboratory. Analyzed advanced beam control concepts in integrated simulations. Began development of the second-generation tactical relay mirror demonstrator including the telescopes, the optics, the associated gimbals, the lightweight optics bench, and electronics. Conducted ground demonstrations of an integrated tactical laser on an aircraft. Working with DARPA, completed preliminary design and began component development to allow integration of their High Energy Liquid Laser Area Defense System (HELLADS) with a beam control system.		12.317	13.583	5.730	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology	PROJECT NUMBER 633151

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Continue integrated tactical beam control field tests to enhance advanced active contour tracking algorithms and advanced jitter reduction in breadth of environments for airborne tactical laser engagements. Continue the development of the second-generation relay mirror demonstrator components. Prepare to demonstrate the use of the second-generation relay mirror components with solid state lasers in the laboratory. Conduct airborne flight demonstrations of a tactical laser against ground targets. With DARPA continue development and begin integration and checkout of beam control, and data analysis subsystems to allow integration of the HELLADS with a beam control system. In FY 2010: Conduct advanced tactical beam control demonstrations. With DARPA, complete major subsystem development, integration, and checkout; conduct low-power beam control field testing to validate target acquisition, tracking, and beam pointing performance to allow integration of the DARPA HELLADS with a beam control system. Complete systems integration and checkout, with the exception of integration with the HELLADS laser device.				
MAJOR THRUST: Develop, integrate, and demonstrate advanced technologies for various space applications including high resolution satellite imaging, object discrimination, small/dim object detection and characterization, laser propagation through atmospheric turbulence, and high accuracy space object tracking. Note: In FY 2010, this thrust was moved from project 11SP, Advanced Optics and Laser Space Technology, to better reflect the relationship with the other efforts in this project. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Build advanced ground diagnostic system for characterizing laser propagation through atmospheric turbulence. Begin to conduct assessment of system performance in a variety of atmospheric conditions. Conduct brassboard integration of advanced sensing and wavefront control technologies.	0.000	0.000	8.168	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology	PROJECT NUMBER 633151

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: All Electric Laser. In FY 2008: Developed electric laser technologies for airborne applications. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	1.847	0.000	0.000	
CONGRESSIONAL ADD: Advanced Fiber Lasers Systems and Components In FY 2008: Not Applicable. In FY 2009: Improve power scaling and efficiency of fiber laser components. Validate approach to eye safe technology, and demonstrate architectural improvements to meet emerging DoD and commercial applications. In FY 2010: Not Applicable.	0.000	0.957	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology	PROJECT NUMBER 633151

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0603270F/ Electronic Combat Technology.	0.000	0.000							Continuing	Continuing
PE 0602605F/ Directed Energy Technology.	0.000	0.000							Continuing	Continuing
PE 0601108F/ High Energy Laser Research Initiatives.	0.000	0.000							Continuing	Continuing
PE 0602890F/ High Energy Laser Research.	0.000	0.000							Continuing	Continuing
PE 0603924F/ High Energy Laser Advanced Technology Program.	0.000	0.000							Continuing	Continuing
PE 0602120A/ Sensors and Electronic Survivability.	0.000	0.000							Continuing	Continuing
PE 0602307A/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0602624A/ Weapons and Munitions Technology.	0.000	0.000							Continuing	Continuing
PE 0603004A/ Weapons and Munitions Advanced Technology.	0.000	0.000							Continuing	Continuing
PE 0602114N/ Power Projection Applied Research.	0.000	0.000							Continuing	Continuing

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification				DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)			R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology	PROJECT NUMBER 633151	
PE 0603175C/ Ballistic Missile Defense Technology	0.000	0.000		Continuing	Continuing
PE 0603883C/ Ballistic Missile Defense Boost Phase Segment.	0.000	0.000		Continuing	Continuing
PE 0602651M/ Joint Non-Lethal Weapons Applied Research.	0.000	0.000		Continuing	Continuing
PE 0602651M/ Joint Non-Lethal Weapons Applied Research.	0.000	0.000		Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000		Continuing	Continuing
Activity Not Provided/The technology efforts in this PE that are supporting future enhancements to airborne lasers have be	0.000	0.000		Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology					PROJECT NUMBER 633152	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
633152: High Power Microwave Development and Integration	10.036	8.270	13.432						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates high power microwave (HPM) and other unconventional weapon 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 covert with no collateral structural or human damage. In addition, millimeter wave force protection technologies are developed and demonstrated. 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.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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 terminated in FY 2009. In FY 2008: Refined airfield defense technologies. Evaluated components as appropriate. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	2.237	0.000	0.000	
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.	3.416	2.333	0.546	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology	PROJECT NUMBER 633152

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Continued to develop and evaluate technologies for Air Force non-lethal weapons applications. Finished initial manufacturer testing and started rebuild of the conventional millimeter-wave device approach for long-range/airborne applications. Continued with hardware development, procurement, fabrication, and testing for the full-power source test stand for long-range/airborne concepts. Provided technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and gathered data relevant to airborne applications. In FY 2009: Continue to develop and evaluate technologies for Air Force non-lethal weapons applications. Complete development of first iteration full-power non-lethal test source for airborne/long range configurations. Continue hardware development, procurement, fabrication, and testing for the full power source test stand for airborne/long range configurations. Provide technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and glean data relevant to airborne applications. In FY 2010: Continue to develop and evaluate technologies for Air Force non-lethal weapons applications. Continue hardware development, procurement, fabrication, and testing for the full-power source test stand for long-range/airborne configurations. Conduct engagement modeling and simulation supporting next generation system requirements refinement and associated flowdown to technical system requirements. Develop, analyze, and evaluate source and thermal subsystem options for next-generation non-lethal systems. Provide technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and glean data relevant to airborne applications.				
MAJOR THRUST: Develop the technology to integrate HPM and other unconventional weapon devices on various platforms, to include aerial, and investigate specific target sets of interest. Develop and demonstrate HPM technologies to disrupt, degrade, damage, or destroy an adversary's electronic systems. Note: Increased funding in FY 2010 for the HPM counter-electronics Joint Capability Technology Demonstration. In FY 2008: Integrated and ruggedized the HPM counter-electronics testbed for field experimentation. Performed HPM system testing and diagnostics. Improved HPM testbed command and control systems for pulsed operation greater than threshold levels. Tested and developed HPM source technology for candidate	4.383	5.937	12.886	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
HPM platforms. Evaluated HPM antenna air-breakdown mechanisms. Integrated and assured designed operation of advanced HPM power combining technology into HPM testbed system. Operated new system to determine the air breakdown threshold on newly developed HPM antenna. Implemented successful redesign of and performed acceptance testing of compact pulsed power component. Integrated newly developed HPM source with compact pulser and tested to assure designed operation. In FY 2009: Conduct laboratory demonstration of the miniaturized and ruggedized HPM counter-electronics testbed. Enhance the system performance and address all electromagnetic interference issues. Develop HPM components for aerial demonstrator system. Test HPM components for performance and ruggedization. Enhance the system performance and address electromagnetic interference issues. Develop command and control systems for the HPM aerial demonstrator. Implement enhancements to HPM source component technology for the aerial demonstration system. Use testbed to determine the air breakdown threshold on new HPM antenna. Perform testing on new HPM source. In FY 2010: Integrate narrowband HPM components into a demonstration HPM counter-electronics aerial platform. Conduct ground testing of the demonstrator HPM aerial system that includes effects testing and environmental testing of the integrated system. Obtain flight certification of the narrowband HPM aerial system. Conduct effects experiments using the narrowband HPM system which includes evaluating battle damage assessment capability. Refine and implement HPM source component technology to overcome unforeseen issues in application systems. Fabricate next-generation compact HPM components for candidate aerial platforms, implement in testbeds, and test operation and performance.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603605F Advanced Weapons Technology	PROJECT NUMBER 633152

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602202F/ Human Systems Technology.	0.000	0.000							Continuing	Continuing
PE 0602605F/ Directed Energy Technology.	0.000	0.000							Continuing	Continuing
PE 0602120A/ Sensors and Electronic Survivability.	0.000	0.000							Continuing	Continuing
PE 0602624A/ Weapons and Munitions Technology.	0.000	0.000							Continuing	Continuing
PE 0602114N/ Power Projection.	0.000	0.000							Continuing	Continuing
PE 0602651M/ Joint Non-Lethal Weapons Applied Research.	0.000	0.000							Continuing	Continuing
PE 0603851M/ Nonlethal Weapons.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603680F Manufacturing Technologies					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	56.376	39.913						Continuing	Continuing
635280: Manufacturing Technologies	0.000	52.414	35.922						Continuing	Continuing
635281: Manufacturing Readiness	0.000	3.962	3.991						Continuing	Continuing

Note

Note: In FY 2009 the AF Manufacturing Technology (ManTech) program transfers to PE 0603680F, Manufacturing Technologies, from PE 0708011F, Industrial Preparedness, to focus on long-term manufacturing and processes and to better align with the Office of the Secretary of Defense ManTech PE.

A. Mission Description and Budget Item Justification

The ManTech program is mandated by Section 2521, Title 10, United States Code, to create an affordable, world-class industrial base manufacturing capability responsive to the warfighter's needs. The Air Force ManTech major program tenets are: development and improvement of technologies and processes; collaboration with government program offices, industry, and academia; investments in generic technologies than can be applied to different applications, technologies beyond reasonable risk level for industry alone; cost-sharing; multiple system/customer applications; potential for significant return on investment; and customer commitment to implement. To this end, ManTech develops, demonstrates, and assesses advanced manufacturing processes and technologies to reduce costs, improve quality/ capability, and shorten cycle times of weapon systems during design, development, production, and sustainment. Where mature processes are not available, laboratory-developed and demonstrated process capabilities are made available for transition into weapon system programs. ManTech objectives are conducted through partnerships with all industry levels, from large prime contractors to small material and parts vendors. Manufacturing Technologies is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates manufacturing technologies for existing upgrades and/or new system developments that have military utility and address warfighter needs.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603680F Manufacturing Technologies

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	0.000	39.729	40.480	
Current BES/President's Budget	0.000	56.376	39.913	
Total Adjustments	0.000	16.647	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.153		
Total Congressional Increases	0.000	5.600		
Total Reprogrammings	0.000	11.200		
SBIR/STTR Transfer	0.000	0.000		

Change Summary Explanation

In FY 2009, Congress added $2.8 million for Advance Casting and Coating Technologies for Aircraft Canopies, $1.6 million for Laser Peening for Friction Stir Welded Aerospace Structures, $0.8 million for Nano-Composite Structures Manufacturing Technology Development, $2.4 million for Next Generation Casting Supplier Base Initiative, $1.2 million for Next Generation Manufacturing Process, $1.6 million for Prepreg Thickness Variability Reduction Program, $1.6 million for Production of Nanocomposites for Aerospace Applications, $1.6 million for Rapid Automated Processing of Advanced Low Observables, and $3.2 million for Technology Insertion Demonstration and Evaluation (TIDE).

C. Performance Metrics

Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603680F Manufacturing Technologies					PROJECT NUMBER 635280	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635280: Manufacturing Technologies	0.000	52.414	35.922						Continuing	Continuing

Note

Note: In FY 2009 the AF Manufacturing Technologies program will transfer to PE 0603680F, Manufacturing Technologies, from PE 0708011F, Industrial Preparedness, to focus on long-term manufacturing technologies and processes and to better align with the Office of the Secretary of Defense ManTech PE.

A. Mission Description and Budget Item Justification

The ManTech program is mandated by Section 2521, Title 10, United States Code, to create an affordable, world-class industrial base manufacturing capability responsive to the warfighter's needs. The Air Force ManTech major program tenets are: development and improvement of manufacturing technologies and processes; collaboration with government program offices, industry, and academia; investments in generic technologies that can be applied to different applications, cost-sharing; multiple system/customer applications; potential for significant return on investment; and customer commitment to implement. To this end, ManTech develops and demonstrates advanced manufacturing processes and technologies to reduce costs, improve quality/capability, and shorten cycle times of weapon systems during design, development, production, and sustainment. Where mature processes are not available, laboratory-developed and demonstrated initial process capabilities are made available for transition into weapon system programs. ManTech objectives are conducted through partnerships with all industry levels, from large prime contractors to small material and parts vendors.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and implement cost-effective maintenance, repair, and manufacturing technologies for sustainment of Air Force weapon systems. Note: In FY 2010, the increase in funding is due to greater emphasis on sustainment and readiness. In FY 2008: Not Applicable. In FY 2009: Continue cost-effective repair and manufacturing technologies for affordable sustainment of aircraft and turbine engine components. Continue Engine Rotor Life Extension (ERLE) technical effort to extend the life of critical, high value rotating engine components, which have been in service and scheduled for retirement. Continue assessments and manufacturing technology development to reduce costs and lead	0.000	6.675	13.982	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
times for high value supply chain commodities. Continue rapid response productivity improvement efforts with selected high value programs. In FY 2010: Continue cost-effective repair and manufacturing technologies for affordable sustainment of both aircraft and turbine engine components. Continue assessments and manufacturing technology development to reduce logistic support costs, lead times for high value supply chain commodities, and cycle times for depot repair. Continue rapid response productivity improvement efforts with selected high value programs.					
MAJOR THRUST: Develop and implement pervasive affordability and producibility issues for various weapon systems and processes, to include manned and unmanned aircraft, advanced tactical missiles, directed energy systems, Command and Control Intelligence, Surveillance and Reconnaissance (C2ISR) platforms, space, structures, propulsion, stealth, and avionics/electronics. Note: In FY 2010, the decrease in funding is due to several efforts ramping down. In FY 2008: Not Applicable. In FY 2009: Continue high value efforts to verify advantages of flexible manufacturing, commercial/military integration, quality processing, and supplier improvements. Continue development of manufacturing capabilities for more affordable low-observable structures. Develop manufacturing capabilities for advanced propulsion technologies. Continue rapid response productivity improvement efforts for selected high value programs. Continue efforts to address critical electronics manufacturing technologies for various C2ISR and space applications in order to improve affordability and producibility. Continue efforts on Active Electronically Scanned Arrays (AESA) radar to enable improved manufacturing processes for reduced costs and cycle times and greater production capacity. Continue efforts on affordable datalink components to enable improved manufacturing processes for reduced costs and cycle times and increased production throughput. Conduct assessments on critical technologies in lab and acquisition programs to ensure affordable, producible technology transition.		0.000	28.983	21.941	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Continue high value efforts to verify advantages of flexible manufacturing, commercial/military integration, quality processing, and supplier improvements. Continue development and demonstration of manufacturing capabilities for more affordable low-observable structures. Develop manufacturing capabilities for advanced propulsion technologies. Continue rapid response productivity improvement efforts for selected high value programs. Continue efforts to address critical electronics manufacturing technologies for various C2ISR and space applications in order to improve affordability and producibility. Continue efforts on Active Electronically Scanned Arrays (AESA) radar to enable improved manufacturing processes for reduced costs and cycle times and greater production capacity of next generation radars. Continue efforts on affordable datalink components to enable improved manufacturing processes for reduced costs and cycle times. Commence development of advanced manufacturing processes for pervasive space needs. Conduct assessments on critical technologies in lab and acquisition programs to ensure affordable, producible technology transition.					
CONGRESSIONAL ADD: Advance Casting and Coating Technologies for Aircraft Canopies. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Advance Casting and Coating Technologies for Aircraft Canopies. In FY 2010: Not Applicable.		0.000	2.792	0.000	
CONGRESSIONAL ADD: Laser Peening for Friction Stir Welded Aerospace Structures. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Laser Peening for Friction Stir Welded Aerospace Structures.		0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603680F Manufacturing Technologies			PROJECT NUMBER 635280	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Nano-Composite Structures Manufacturing Technology Development. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Nano-Composite Structures Manufacturing Technology Development. In FY 2010: Not Applicable.		0.000	0.798	0.000	
CONGRESSIONAL ADD: Next Generation Casting Supplier Base Initiative. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Next Generation Casting Supplier Base Initiative. In FY 2010: Not Applicable.		0.000	2.394	0.000	
CONGRESSIONAL ADD: Next Generation Manufacturing Process. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Next Generation Manufacturing Process.		0.000	1.197	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603680F Manufacturing Technologies			PROJECT NUMBER 635280	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Prepreg Thickness Variability Reduction Program. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Prepreg Thickness Variability Reduction Program. In FY 2010: Not Applicable.		0.000	1.596	0.000	
CONGRESSIONAL ADD: Production of Nanocomposites for Aerospace Applications. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Production of Nanocomposites for Aerospace Applications. In FY 2010: Not Applicable.		0.000	1.596	0.000	
CONGRESSIONAL ADD: Rapid Automated Processing of Advanced Low Observables. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Rapid Automated Processing of Advanced Low Observables.		0.000	1.596	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603680F Manufacturing Technologies	PROJECT NUMBER 635280

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: Technology Insertion Demonstration and Evaluation (TIDE). In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Technology Insertion Demonstration and Evaluation (TIDE). In FY 2010: Not Applicable.	0.000	3.191	0.000	

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0708011F/ Industrial Preparedness	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

All major contracts in this Program Element were awarded after full and open competition.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603680F Manufacturing Technologies					PROJECT NUMBER 635281	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635281: Manufacturing Readiness	0.000	3.962	3.991						Continuing	Continuing

Note

Note: In FY 2009 the AF Manufacturing Technologies program will transfer to PE 0603680F, Manufacturing Technologies, from PE 0708011F, Industrial Preparedness, to focus on long-term manufacturing and processes and to better align with the Office of the Secretary of Defense ManTech PE.

A. Mission Description and Budget Item Justification

Manufacturing readiness of technologies is a key concern when identifying and mitigating risk to successfully transition these technologies and systems into production. Within each product sector (aeronautical, space, munitions/directed energy, and C2ISR), manufacturing readiness assessments (MRAs) will be applied and manufacturing readiness levels (MRLs) utilized to gauge and manage manufacturing related issues. Advanced Technology Demonstrations (ATDs) will be used when appropriate to aid in efficient transition. Selected acquisition programs will also be assessed to determine readiness for milestone decisions and/or to reduce manufacturing risk. Pervasive, generic and system-specific manufacturing maturation plans will be developed and implemented based on the assessments to reduce overall program risk and to provide an increased awareness of manufacturing issues throughout major weapon system life cycles. Generic and pervasive manufacturing issues will be identified and considered as potential ManTech programs to transition advanced manufacturing technologies into multiple sectors.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Through application of MRAs, develop and implement manufacturing maturation plans to improve affordability and producibility and mitigate transition risk from development to production. In FY 2008: Not Applicable. In FY 2009: Develop Manufacturing Maturation Plans (MMPs) for all Category I ATDs and selected high-visibility program based on MRA. Selected MMPs will be executed to increase the MRL and improve technology transition to production. MRAs will also be conducted on selected Air Force acquisition programs to aid in Milestone Decision Reviews and/or to mitigate cost, schedule, or rate issues. Manufacturing risk will be documented based on the assessments and delivered to the appropriate program offices. Pervasive manufacturing issues discovered during the assessments will be vetted through the ManTech requirements process.	0.000	3.962	3.991	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603680F Manufacturing Technologies	PROJECT NUMBER 635281

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Continue development of Manufacturing Maturation Plans (MMPs) for Category I ATDs and selected high-visibility programs based on MRA. Selected MMPs will be executed to increase the MRL and improve technology transition to production. MRAs will also be conducted on selected Air Force acquisition programs to aid in Milestone Decision Reviews and/or to mitigate cost, schedule, or rate issues. Manufacturing risk will be documented based on the assessments and delivered to the appropriate program offices. Pervasive manufacturing issues discovered during the assessments will be vetted through the ManTech requirements process.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities	0.000	0.000							Continuing	Continuing
Activity Not Provided/ PE, 0708011F, Industrial Preparedness	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

All major contracts in this Program Element were awarded after full and open competition.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603788F Global Information Dev/Demo					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	0.000	39.708						Continuing	Continuing
635319: Anticipatory OPS Intent and Response	0.000	0.000	10.613						Continuing	Continuing
635320: Assured Worldwide Connectivity	0.000	0.000	11.750						Continuing	Continuing
635321: Global Battlespace Awareness	0.000	0.000	9.870						Continuing	Continuing
635322: Knowledge Management and Computing	0.000	0.000	7.475						Continuing	Continuing

Note

Note: Prior to FY 2010, efforts in this PE were performed in PE 0603789F, C3I Advanced Development.

A. Mission Description and Budget Item Justification

This program develops and demonstrates Air Force Enterprise-Centric Information 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 Global Battlespace Awareness project develops, integrates, and demonstrates advanced technologies to achieve comprehensive net-centric operations and total battlespace awareness by using and exploiting information from all sources. The Assured Worldwide Connectivity project provides advanced net-enabled architectures and communications technologies in support of global military operations including a secure information grid for worldwide information exchange of near-real-time multimedia (i.e., voice, data, video, and imagery) information. In addition, this project develops and demonstrates advanced optical networking and communications for Air Force air and space-based information exchange on and between platforms. These developments implement and enable high capacity secure, assured networks for worldwide information exchange of near-real-time multimedia (i.e., voice, data, video, and imagery). These optical networks will be rapidly deployable, mobile, interoperable, and seamless between Air and Space Operations Centers (AOC) and air and space based platforms either en route or in theater. This project also provides the tools and applications leading to the development and integration of cyber deterrence technologies resulting in a strategic capability of cyber dominance within the secure information grid. The Knowledge Management and Computing project develops the technology applications that will provide for a secure, tailored, seamless exchange of information among producers, consumers and managers of information relevant to a particular community of interest (COI). The project also provides the development of interactive and real-time computing technologies that greatly improve the usability of high performance computing for the exchange,

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
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utilization, and management of information in the enterprise. The Anticipatory Ops Intent and Response project develops the technologies for dynamic planning and execution with the accuracy, fidelity, and timeliness needed to dominate the battlespace. This project will develop and demonstrate technologies necessary for dynamic decision making to create, plan, and execute complex effects on compressed time scales required for tomorrow's conflicts regardless of the warfighting domain - air, space, or cyber. 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.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	0.000	0.000	0.000	
Current BES/President's Budget	0.000	0.000	39.708	
Total Adjustments	0.000	0.000	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	0.000		
Total Congressional Increases	0.000	0.000		
Total Reprogrammings	0.000	0.000		
SBIR/STTR Transfer	0.000	0.000		

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603788F Global Information Dev/Demo					PROJECT NUMBER 635319	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635319: Anticipatory OPS Intent and Response	0.000	0.000	10.613						Continuing	Continuing

Note

Note: Prior to FY 2010, these efforts were performed in PE 0603789F, C3I Advanced Technologies, Project 4872.

A. Mission Description and Budget Item Justification

In order to achieve information dominance, the Air Force must be able to monitor, assess, plan and execute (MAPE) 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 through stability operations). This project develops and integrates decision support technologies that will enhance the commander's ability to anticipate and dominate the future battlespace by more effectively forecasting the evolution of the battlespace and by more rapidly generating options to "virtually checkmate" the adversary. It develops the decision aid technologies and processes to plan the use of various assets and assess their effects in the battlespace. It provides a tailorable information environment to effectively portray complex data sets accurately in real-time.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4872. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Continue developing 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 synchronized with precision munitions to determine successful achievement of command intent in time and location. Continue campaign of experimentation to quantitatively measure transformational command and control concepts enabled by net centric warfare	0.000	0.000	1.701	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
capabilities. Initiate an investigation of space C2 planning and scheduling technologies to enable enhanced space operations. Start the development of an integrated C2 tasking capability to enable seamless full spectrum options to be reasoned over and recommendations provided to the operator that will meet commander's intent. Develop capability to generate a user defined operational picture across the air, space, and cyber domains at the strategic, operational, and tactical levels.					
MAJOR THRUST: Develop and demonstrate the integration of planning tools and information-base intelligent agents for adaptive preplanning and decision support tools for Air Force command and control systems. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4872. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Continue development of capabilities to be more agile within a net centric enabled environment. Continue development of timely option generation, selection, and coordination capabilities that account for uncertainty and missing and erroneous information, and supports intuitive decision making processes. Continue to develop dynamic workflow and workload management capabilities to manage the command and control enterprise. Initiate development of a capability to assess adverse events that could potentially impact air and space mobility operations and suggest courses of action (COA) that could be initiated to continue operations. Investigate methods to evaluate mobility courses of action covering planning through assessment that anticipates multiple constraints and provides prioritized feasible recommendations that meets commander's intent. Develop capability to assess the impact of cyber on air and space C2 operations and suggest courses of action to be initiated to continue operations in the face of cyber threats.		0.000	0.000	4.450	
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-		0.000	0.000	4.462	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
order) at the right place at the right time, anywhere, anytime. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4872. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Initiate the development and demonstrate real-time information technologies that enable a decision maker to comprehend their current situational awareness by assessing an operation's progress against desired effects (reflective) and identifying key indicators and observables to assist in anticipating future success or failure of a campaign (predictive). Continue investigating the methods to enable a decision support environment that enables the decision maker to anticipate and shape all aspects of the future battlespace. Continue development of predictive battlespace planning tools with the ability to reason over models of the "enemy as a system." Evaluate competing approaches for the analysis of cascading effects in real-time for diverse courses of action. Initiate design of a tool suite for rapidly wargaming proposed actions against an intelligent adversary. Develop and demonstrate capability to enable integrated traditional and cyber effects based assessment for air and space operations centers. Develop capability to integrate kinetic and non-kinetic assetsin an integrated tasking order to achieve desired commander's effects.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/Not applicable	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not applicable

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603788F Global Information Dev/Demo	PROJECT NUMBER 635319

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603788F Global Information Dev/Demo					PROJECT NUMBER 635320	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635320: Assured Worldwide Connectivity	0.000	0.000	11.750						Continuing	Continuing

Note

Note: Prior to FY 2010, these efforts were performed in PE 0603789F, C3I Advanced Technologies, Project 4216.

A. Mission Description and Budget Item Justification

The Air Force requires advanced net-enabled architectures and communications technologies in support of global kinetic and non-kinetic military operations including a secure information grid for worldwide information delivery and exchange of near-real-time information including voice, data, video, and imagery. 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. This project provides secure information transmission capabilities for a persistent, global, survivable communications backbone network accessible for warfighters operating in all domains; it provides self-healing, self-configuration, anti-jam communication networking capabilities; and it provides enterprise networking capabilities for agile, policy-based network management. In addition, this project develops and demonstrates advanced optical networking and communications for Air Force air and space-based information exchange on and between platforms including development of highly integrated multi-gigabit optical and radio frequency networks, all optical data routers, optical backbone interface circuits for on board information exchange, and integrated electronic, adaptive optic systems for atmospheric mitigation. The Air Force also requires the ability to deliver sovereign options in cyberspace through the development and integration of cyber attack, cyber defense, and cyber support technologies for a strategic capability of cyber dominance. This project develops the ability to deliver: 1) Cyber attack capabilities: access, stealth and persistence, cyber intelligence, and weapons delivery, 2) Cyber defense capabilities: attack detection, attack attribution, and response automation, and 3) Cyber support capability: situational awareness and war gaming.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4216. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	0.000	0.000	1.432	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Continue development of small form-factor networking and reachback capability. Initiate design and demonstration of soldier interface, perform initial flight test.				
MAJOR THRUST: Proactively defend cyberspace through cyber situational awareness, detecting and defeating cyber threats, and surviving through adaptation and self-generation. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4216. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Demonstrate a fleet of 1,000 cooperative, positively controlled, trusted agents that can defend mission critical information system assets and collect actionable CybINT for cyber situation awareness. Continue 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. Develop capability to geo-locate red, blue, and non-combatant IP addresses and devices globally and locally to achieve better situational awareness to efficiently position cyber defenses. Initiate development of a complete situational awareness capability of cyber network assets, both red and blue forces, to include both virtual and physical cyber assets.	0.000	0.000	4.288	
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: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4216. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	0.000	0.000	3.336	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Continue to analyze development of additional offensive cyber operations capabilities, integrated kinetic and cyber operations planning and execution capabilities, and cyber command and control (Cyber C2) operations functions. Complete selected offensive cyber capabilities to access, remain stealthy, gather intelligence, and affect adversary information and information systems. Finalize technology demonstration plans.					
MAJOR THRUST: 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: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4216. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Initiate advanced demonstration of high capacity assured access (anti-jam) communications for global spectrum dominance. Develop Quality of Service (QoS) enabled information management and dissemination combined with network policy language for efficient, prioritized information exchange.		0.000	0.000	0.230	
MAJOR THRUST: Integrate and demonstrate a resilient and self-regenerating information 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, and possesses robust anti-tamper and software protection features. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4216. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		0.000	0.000	1.176	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Begin integration of technologies to introduce synthetic diversity into friendly information systems. Initiate integration of anti-tamper software protection technology with enterprise information systems.				
MAJOR THRUST: Design, develop, and demonstrate flight ready systems consisting of high capacity radio frequency (RF) and optical components and architectures for next generation platform communications for avionics and satellite systems, and also for wireless in-flight communications systems. These RF and optical communications components are very compact, highly integrated and tolerant to avionics and space environments. Flight test systems will be developed and installed in suitable aircraft and satellite systems and demonstrated in an in-flight environment. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4216. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Complete the design of higher throughput RF waveform data link for operation under adverse weather conditions. Begin fabrication of several flight test ready RF waveform data link systems.	0.000	0.000	1.288	

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/Not applicable	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not applicable

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635321: Global Battlespace Awareness	0.000	0.000	9.870						Continuing	Continuing

Note

Note: Prior to FY 2010, these efforts were performed in PE 0603789F, C3I Advanced Technologies, Project 4072.

A. Mission Description and Budget Item Justification

In order to achieve information dominance, the Air Force must be able to monitor, assess, plan and execute (MAPE) 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 through stability operations). This project develops, integrates, and demonstrates advanced technologies to achieve comprehensive net-centric operations and Predictive Battlespace Awareness (PBA) using information from all sources. 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 exploitation, fusion, processing, storage, and retrieval, as well as technologies for machine reasoning, pattern recognition, and timeline analysis.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4072. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Initiate 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, infrastructure areas, lines of communication). Initiate development of techniques for analyzing and assessing activities to support situation assessment. Complete demonstration of integrated	0.000	0.000	2.973	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
intelligence data and analysis products to produce anticipatory ground to space awareness picture. Complete development of multi-sensor exploitation tools to enable characterization and assessment of adversary satellites. Expand previous signal processing developments to a range of progressive RF threats and hardware including communications systems and radar. Initiate research and demonstrate the performance gains with active distributed sensing and processing and identify the limitations for further research. Missions include detection, discrimination, location, tracking and targeting of advanced Low Probability of Intercept (LPI) enemy threats.					
MAJOR THRUST: 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. (OLD 4072) FY 2008: Not Applicable. FY 2009: Not Applicable. In FY 2010: Finalize evaluation and support toolsets for advanced fusion algorithms and provide community accepted measures of performance across all efforts. Develop capability to integrate a variety of user definable display technologies to visualize individual data set contexts for better situational awareness.		0.000	0.000	0.646	
MAJOR THRUST: Develop and demonstrate capabilities for reasoning and learning, text understanding, link and group discovery, and advanced analysis for situational awareness and understanding. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4072. FY 2008: Not Applicable. FY 2009: Not Applicable.		0.000	0.000	2.215	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Initiate development of a text extraction capability that enables users to fine-tune the extractor, based on their specialized knowledge of the domain, to achieve higher performance. Initiate development of techniques for abnormality detection in evidence of connections and paths of different types to find unusual circumstances. Initiate development of tools and services for Advanced Behavioral Modeling Techniques and advanced capabilities for analysis that integrate situation understanding, situation monitoring, and event anticipation.				
MAJOR THRUST: Develop models to provide detailed understanding of the adversary's probable intent and future strategy in order to identify adversary COAs, determine the most likely COA, and determine the COA most dangerous to friendly forces or mission accomplishment. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4872. FY 2008: Not Applicable. FY 2009: Not Applicable. In FY 2010: 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 (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 investigation in the capability to manage multiple possible future adversary courses of actions prioritized based on current and future (projected) impact/threat. Initiate investigation in developing screening techniques that give the analyst/decision maker insight into the contribution or sensitivity of various factors on a given observable/response. Initiate investigation of techniques that will allow model adaptation to new regions and nations.	0.000	0.000	3.390	
MAJOR THRUST: Develop and demonstrate the mechanisms required to achieve robust, tamperproof, self-authenticating data codes and executables for trusted/optimized computing as part of net centric operations	0.000	0.000	0.646	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603788F Global Information Dev/Demo	PROJECT NUMBER 635321

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
and situational awareness in the battlespace environment. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4216. FY 2008: Not Applicable. FY 2009: Not Applicable. In FY 2010: Initiate the application of developed watermarking technologies to development programs of record, targeting intelligence applications. Integrate audio watermarking technologies into a development program, providing information assurance and provenance to the data. Begin development of protocols for the application of watermarking in specific provenance, pedigree and information assurance scenarios.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/Not applicable	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not applicable

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603788F Global Information Dev/Demo					PROJECT NUMBER 635322	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635322: Knowledge Management and Computing	0.000	0.000	7.475						Continuing	Continuing

Note

Note: Prior to FY 2010, these efforts were performed in PE 0603789F, C3I Advanced Technologies, Project 4872.

A. Mission Description and Budget Item Justification

The Air Force requires technologies that will provide the decision maker and staff with seamless access to tailored information within a mobile, dynamic, and scalable, globally distributed Air and Space Operations Center (AOC) as well as among other producers, consumers, and managers of information relevant to other particular communities of interest (COI). This project demonstrates the enterprise management capabilities needed for the rapid distribution of actionable information as well as the needed advances in high performance computing to ensure this complex capability. This project develops an agile information environment that focuses on quality of service, transformation and brokering, a federated information environment focusing the relationship among the members of the environment, a secure cross-domain information sharing capability that focuses on the security layer and inter-COI information exchange in different security domains, and a collaboration environment focusing on the information workflow layer of the enterprise. This project will also develop: 1) a computational science and engineering capability demonstrating new models of computation, 2) novel approaches for high performance, interactive, net-centric, distributed and embedded computing systems, and 3) the technological tools enabling affordable, large scale, complex, software intensive systems.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop and demonstrate computer architectures with greater capacity and sophistication to enable game changing computing power to the warfighter, anywhere, anytime. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4872. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Initiate development of petaflops embedded on-demand computing. Evaluate options for on-board processing of common sensor algorithms. Complete design of a fungible node for autonomous systems.	0.000	0.000	0.493	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603788F Global Information Dev/Demo	PROJECT NUMBER 635322

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Initiate development of a stacked chip architecture for cognitive and autonomous systems. Develop scalable stacked chip architecture for highly modular computing system for cognitive and autonomous systems.				
MAJOR THRUST: Demonstrate how a publish, subscribe, and query information management paradigm can enable vertical and horizontal integration of Air Force information systems through brokered federated information spaces. 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: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4872. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop secure, accreditable services to assist in information sharing between two or more independent security domains while preventing information disclosure to untrustworthy users. Develop a single multi-level repository which can securely store information containing multiple security levels but can be accessed from multiple security domains. This capability will promote IT consolidation and reduce the duplicate information storage within each security domain. Develop a common security labeling methodology that promotes the automatic flow of time-sensitive information among different security domains. Provide for security labeling assurance & pedigree to enforce information access policies. Develop approaches for applying secure information sharing concepts to mobile ad-hoc networks which are often characterized by low-bandwidth and intermittent connectivity. Initiate development of a method to securely link data and metadata. Initiate development of an adaptive security policy expression and enforcement mechanism for automated information review and release among different security domains. Develop and perform field demonstrations of cross domain sharing mechanisms in an operational setting to support a prototype installation command system. Demonstrate content-based dissemination mechanisms. Begin development of a mature open-systems based implementation of Distributed Mission Operations (DMO) infrastructure that leverages context-aware information management technologies to enable the rapid incorporation and interaction of live, virtual	0.000	0.000	5.376	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603788F Global Information Dev/Demo			PROJECT NUMBER 635322	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
and constructive entities and systems. Develop and demonstrate capability to intelligently collect, correlate, and analyze multi-source threat data across multiple security domains to assist cyber operators determine minimum impact of detected threat events.					
MAJOR THRUST: Demonstrate expertise in applied math and algorithms, optimization for modern architectures including multi-tiered memory hierarchies, multi-core processors and heterogeneous architectures as well as secure web interfacing to rapidly accelerate AFRL computational science and engineering applications at least 100x. Develop and demonstrate predictable software system execution, i.e; the software behaves as expected - nothing more, nothing less, and predictable software acquisition, i.e;. technologies based on modeling, libraries, formal methods and analysis techniques enabling development of software intensive systems. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4872. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Initiate rapid reaction identifying and optimizing codes demonstrating at least 100x improvement through the techniques applied. Initiate predictable software testing. Create tools for exploiting mechanisms in emerging technology to ease the complexity, understanding and managing software in embedded and software-intensive systems and enabling rapid construction/modernization of provably correct systems and guaranteed interoperability providing trusted components and systems.		0.000	0.000	0.447	
MAJOR THRUST: Demonstrate how agile information management services enable effective information sharing in a tactical environment. Efforts focus on efficient bandwidth utilization, quality of service, fault tolerance and scalability. Note: Prior to FY 2010, efforts were conducted in PE 0603789F, Project 4872. In FY 2008: Not Applicable.		0.000	0.000	1.159	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603788F Global Information Dev/Demo	PROJECT NUMBER 635322

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Not Applicable. In FY 2010: Develop and demonstrate Pub/Sub/Query mechanisms for tactical airborne platforms such as Global Hawk and Joint STARS. These tactical sharing mechanisms will be evaluated against operational concepts of employment and the ability to perform the operational objectives.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/Not applicable	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not applicable

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603789F C3I Advanced Development					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	31.781	33.902	0.000						Continuing	Continuing
634072: Dominant Battlespace Awareness	5.784	7.946	0.000						Continuing	Continuing
634216: Battlespace Information Exchange	11.464	14.960	0.000						Continuing	Continuing
634872: Aerospace Information Dominance	14.533	10.996	0.000						Continuing	Continuing

Note

Note: In FY 2010 efforts in this PE move to PE 0603788F, Global Information Dev/Demo.

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. 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, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603789F C3I Advanced Development

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	32.821	30.103	42.165	
Current BES/President's Budget	31.781	33.902	0.000	
Total Adjustments	-1.040	3.799	0.000	
Congressional Program Reductions	0.000	-0.008		
Congressional Rescissions	0.000	-0.093		
Total Congressional Increases	0.000	3.900		
Total Reprogrammings	-0.320	0.000		
SBIR/STTR Transfer	-0.720	0.000		

Change Summary Explanation

Note: In FY 2009, Congress added $3.9 million for Massively Parallel Optical Interconnects for Battlespace Information Exchange.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603789F C3I Advanced Development					PROJECT NUMBER 634072	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
634072: Dominant Battlespace Awareness	5.784	7.946	0.000						Continuing	Continuing

Note

Note: In FY 2010 this effort moves to PE 0603788F, Project 5321, Global Battlespace Awareness.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Developed a real-time Signal Processing and Geolocation capability for emerging commercial communications used by military and asymmetrical threats. Developed airborne-cued, ground-based signal processing and geolocation capability. 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. Develop multi-sensor exploitation tools to enable characterization and assessment of adversary satellites. Integrate intelligence data and analysis products to produce anticipatory ground to space awareness picture.	1.904	2.172	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603789F C3I Advanced Development			PROJECT NUMBER 634072	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
MAJOR THRUST: 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. In FY 2008: Continued 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. Developed methods for combining post-event processing of intelligence data with real-time streaming intelligence data for indications and warning functions. Initiated 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. Initiated investigation of Fusion of Cyber Intelligence (CYBINT) with traditional INTs. 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. Develop the capability to extract events of interest form unstructured text in order to enable automated visualization of events on timelines and maps. In FY 2010: Not Applicable.		3.880	5.774	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603789F C3I Advanced Development	PROJECT NUMBER 634072

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602702F/ Command, Control, and Communications.	0.000	0.000							Continuing	Continuing
PE 0603203F/ Advanced Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0603742F/ Combat Identification Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603789F C3I Advanced Development					PROJECT NUMBER 634216	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
634216: Battlespace Information Exchange	11.464	14.960	0.000						Continuing	Continuing

Note

Note: In FY 2010 this effort moves to PE 0603788F, Project 5320, Assured Worldwide Connectivity.

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, services, 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Completed 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). 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.	0.903	1.134	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603789F C3I Advanced Development			PROJECT NUMBER 634216	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
MAJOR THRUST: Proactively defend cyberspace through cyber situational awareness, detecting and defeating cyber threats, and surviving through adaptation and self-regeneration. Note: This effort transitioned in FY 2008 from Applied Research PE 0602702F, Project 4519, into this PE. In FY 2008: Developed 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. Developed secure data sharing to prevent the disclosure of sensitive information to untrustworthy users. 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. In FY 2010: Not Applicable.		0.772	2.710	0.000	
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 effort completes in FY 2009, and does not transfer to PE 0603788F. In FY 2008: Tested and validated the modeling and simulation capability using real world scenarios to determine the accuracy and real-time nature of the capability. Established enhancements to the current modeling capability and to assess processing requirements.		0.623	1.374	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603789F C3I Advanced Development	PROJECT NUMBER 634216

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2010: Not Applicable.				
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 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 completes in FY 2009, and does not transfer to PE 0603788F. In FY 2008: Designed and developed 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. 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.). In FY 2010: Not Applicable. In FY 2011: Not Applicable.	0.735	1.034	0.000	
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	1.338	2.130	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603789F C3I Advanced Development			PROJECT NUMBER 634216	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
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 transitioned in FY 2008 from Applied Research PE 0602702F, Project 4519, into this PE. In FY 2008: Initiated development of offensive cyber capabilities to access, remain stealthy, gather intelligence, and affect adversary information and information systems. Developed technology demonstration plans for cyber operations. In FY 2009: Analyze development of selected offensive cyber operations capabilities, integrated kinetic and cyber operations planning and execution capabilities, and cyber command and control (Cyber C2) operations functions. In FY 2010: Not Applicable. In FY 2011: Not Applicable.					
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 2008 and $3.9 million in FY 2009 Congressional add funding. In FY 2008: Developed 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. Initiated 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. Initiated investigation to provide assured access (anti-jam) covert high capacity spectrum dominance for global networking, while denying the adversary the same. Conducted		7.093	6.578	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603789F C3I Advanced Development			PROJECT NUMBER 634216	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Congressionally directed effort for Massively Parallel Optical Interconnects for Battlespace Information Exchange to expand the number of wavelengths by utilizing FY2007 developments in flip-chip mounting of different lasers to a common dielectric silicon optical bench (SiOB). This represents a significant breakthrough in optoelectronic device technology. 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 airborne and ground information environments. Continue investigation to provide assured access (anti-jam) covert high capacity spectrum dominance for global networking, while denying the adversary the same. Conduct Congressionally directed effort for Massively Parallel Optical Interconnects for Battlespace Information Exchange. In FY 2010: Not Applicable. In FY 2011: Not Applicable.					

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603789F C3I Advanced Development	PROJECT NUMBER 634216

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602702F/ Command, Control, and Communications.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603789F C3I Advanced Development					PROJECT NUMBER 634872	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
634872: Aerospace Information Dominance	14.533	10.996	0.000						Continuing	Continuing

Note

Note: In FY 2010 efforts moves to PE 0603788F, Project 5321, Global Battlespace Awareness, Project 5322, Knowledge Management and Computing, and Project 5319, Anticipatory Ops Intent and Response.

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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
(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. Note: In FY 2010 this effort moves to PE 0603788, Project 5319, Anticipatory Ops Intent and Response. (U) In FY 2008: Completed development of capabilities that allow a networked enabled operations center to plan, direct, coordinate air force assets across security boundaries in a coalition environment. Developed and demonstrated 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	3.971	1.516	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
visualization, and seamless collaboration. Developed a campaign of experimentation to quantitatively measure transformational command and control concepts enabled by net centric warfare capabilities. Demonstrated command and control decision-support capabilities. Developed 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. Completed 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. Developed polymorphic (adaptable) computing technology for persistent surveillance systems using faster processing and greatly reduced size, weight, and power requirements for processing hardware. Developed and applied 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. 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 MLS/ MSLS middleware technologies for persistent surveillance systems to support user access/denial of information at multiple security levels. In FY 2010: Not Applicable.					
(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		1.204	0.690	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
systems. Note: In FY 2010, this effort moves to PE 0603788F, Project 5319, Anticipatory Ops Intent and Response. In FY 2008: Completed development of improved synchronization among Global Strike and Global Mobility Force participants within multiple theaters and global Civil air traffic management (ATM). Completed automated machine-to-machine exchange of selected information capabilities between CAF aircraft, MAF aircraft, and their respective command and control elements. Completed 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. Demonstrated 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. Completed 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. 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 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. In FY 2010: Not Applicable.					
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. Note: In FY 2010, this effort moves to PE		3.431	3.290	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
0603788F, Project 5319, Anticipatory Ops Intent and Response, except for the efforts in brackets in FY 2009, which move to Project 5321, Global Battlespace Awareness. In FY 2008: Demonstrated concepts and technologies supporting effects-based planning, execution, and assessment by enabling the generation, tasking, and assessment of effects-based tasking. Demonstrated technologies to allow operations center personnel to assess, in near-real-time, various courses of action (COA) options based upon command intent. Developed technologies to capture and assess integrated cause-and-effect (first, second, and third order) relationships endemic to this "enemy as a system." Completed 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. Completed the development of techniques to continually assess status of planned actions against adversary systems to determine whether predicted effects are actually achieved. Initiated an analysis of cascading effects in real-time for diverse courses of action. Initiated 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). Initiated investigation of ability to forecast potential adversaries and events based on indications of known evidence and projected known and/or anticipated threat(s). 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 ability to appraise and plan the "best" blue course of action for 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 and Quality of Assurance integration to the information system enterprise during malicious and non-malicious faults. In FY 2010: Not Applicable.				

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop and demonstrate high performance computing for size, weight, and power-limited applications, and emulate older computing components. Note: In FY 2010, this effort moves to PE 0603788F, Project 5322, Knowledge Management and Computing. In FY 2008: Developed high performance computing for size, weight, and power-limited applications. Transitioned power efficient processors to DoD users by addressing power, programmability, and radiation issues. Developed and demonstrated emulation of older computing components and boards, allowing re-use of existing software while gaining the advantages of modern semiconductor processing technology. 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 analysis of hardware and system/support software that enables complex software to be readily composed. In FY 2010: Not Applicable.		1.303	1.078	0.000	
(U) MAJOR THRUST: 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: In FY 2010, this effort moves to PE 0603788F, Project 5322, Knowledge Management and Computing. In FY 2008: Developed tactical and federated COI infospheres to manage information objects from diverse sources and data environments within and across the tactical edge. Applied adaptor technology to allow existing Air Force systems to rapidly integrate with and utilize COI information sources, with a special		2.824	4.422	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Completed 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). Initiated the development of technologies that enable a generic methodology for the dissemination of information across multiple security level boundaries. Developed capability integrating tactical and edge user information management requirements. Initiated development of information transformation services and adaptive information management services that learn, self-configure, self-manage, and are self-healing. Initiated 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. Developed COI Infospheres in the areas of context aware collaborative user interfaces and semantic interoperability. 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. 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. In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: Collaboration Gateway.	1.000	0.000	0.000	

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APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603789F C3I Advanced Development			PROJECT NUMBER 634872	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Conducted Congressionally directed effort for Collaboration Gateway to develop the capabilities of the Collaboration Gateway Architecture to support cross-domain audio conferencing, white-boarding, interoperability of commercial collaboration tools, and enhanced federated information search & retrieval capabilities.. In FY 2009: Not Applicable. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Interoperability Network to Fuse and Exchange Real-Time Information. In FY 2008: Conducted Congressionally directed effort for Interoperability Network to Fuse and Exchange Real-Time Information to demonstrate a threat agent network capable of providing chemical detection, intrusion detection, physical security, surveillance, command and control, wireless connectivity between the screening and environmental monitoring sites and to the command center and other existing technology at Liberty Island National Monument using the AFRL Integrated Information Management System (IIMS). In FY 2009: Not Applicable. In FY 2010: Not Applicable.		0.800	0.000	0.000	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602702F/ Command, Control, and Communications.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603924F High Energy Laser Advanced Technology Program					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	3.688	4.002	3.831						Continuing	Continuing
635095: High Energy Laser Advanced Technology Program	3.688	4.002	3.831						Continuing	Continuing

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 weapons have many potential advantages, including speed-of-light delivery, precision target engagement, significant magazine depth, low-cost per kill, and reduced logistics requirements. HEL weapons 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/no collateral damage. This program is part of an overall Department of Defense (DoD) HEL Science and Technology program. 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.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	3.790	4.013	3.890	
Current BES/President's Budget	3.688	4.002	3.831	
Total Adjustments	-0.102	-0.011	0.000	
Congressional Program Reductions	0.000	0.000		
Congressional Rescissions	0.000	-0.011		
Total Congressional Increases	0.000	0.000		
Total Reprogrammings	0.000	0.000		
SBIR/STTR Transfer	-0.102	0.000		

Change Summary Explanation

Not Applicable.

C. Performance Metrics

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603924F High Energy Laser Advanced Technology Program

Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635095: High Energy Laser Advanced Technology Program	3.688	4.002	3.831						Continuing	Continuing

A. Mission Description and Budget Item Justification

N/A

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. In FY 2008: Under the Joint High Power Solid State Laser (JHPSSL) project, continued build-up and integration of the laser modules for the 100 kilowatt device. Initiated planning for a high-power beam director integrated demonstration, utilizing maturing solid-state laser technologies. In FY 2009: Under JHPSSL, complete the integration of modules for the 100 kilowatt project and demonstrate performance in a laboratory environment. In FY 2010: Initiate a joint high-power beam director development effort, suitable for mating with a JHPSSL device.	3.688	4.002	3.831	

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APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603924F High Energy Laser Advanced Technology Program	PROJECT NUMBER 635095

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0602890F/ High Energy Laser Research.	0.000	0.000							Continuing	Continuing
PE 0603444F/ Maui Space Surveillance System.	0.000	0.000							Continuing	Continuing
PE 0603605F/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0601108F/ High Energy Laser Research Initiatives.	0.000	0.000							Continuing	Continuing
PE 0603883C/ Ballistic Missile Defense Boost Phase Segment.	0.000	0.000							Continuing	Continuing
PE 0602605F/ Directed Energy Technology.	0.000	0.000							Continuing	Continuing
PE 0602307A/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0602114N/ Power Projection Applied Research.	0.000	0.000							Continuing	Continuing
PE 0602120A/ Sensors and Electronic Survivability.	0.000	0.000							Continuing	Continuing
PE 0603004A/ Weapons and Munitions Advanced Technology.	0.000	0.000							Continuing	Continuing
PE 0602702E/ Tactical Technology.	0.000	0.000							Continuing	Continuing
	0.000	0.000							Continuing	Continuing

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification			DATE: May 2009	
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PE 0603175C/ Ballistic Missile Defense Technology.				
PE 0602651M/ Joint Non-Lethal Weapons Applied Research.	0.000	0.000	Continuing	Continuing
PE 0603651M/ Joint Non-Lethal Weapons Technology Development.	0.000	0.000	Continuing	Continuing
Activity Not Provided/N/A	0.000	0.000	Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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