# Department of Defense Fiscal Year (FY) 2011 President's Budget

February 2010



**Air Force** 

Justification Book Volume 1

Research, Development, Test & Evaluation, Air Force - 3600

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Air Force • President's Budget FY 2011 • RDT&E Program

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#### Fiscal Year 2011 Program And Budget Estimates RDT&E Descriptive Summaries Scientific and Technology Budget Activities February 2010

#### INTRODUCTION AND EXPLANATION OF CONTENTS

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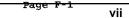
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#### Department of the Air Force FY 2011 President's Budget Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request Summary (Dollars in Thousands)

20 Jan 2010

Summary Recap of Budget Activities	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 0C0	FY 2011 Total Request
Basic Research	446,388	482,776		482,776	500,473		500,473
Applied Research	1,190,223	1,221,221		1,221,221	1,181,420		1,181,420
Advanced Technology Development	717,735	758,667		758,667	509,305		509,305
Advanced Component Development & Prototypes	2,242,097	1,841,754		1,841,754	1,503,007	16,000	1,519,007
System Development & Demonstration	3,995,427	3,844,675		3,844,675	3,549,475	30,000	3,579,475
RDT&E Management Support	1,484,616	1,062,440	3,291	1,065,731	1,084,374		1,084,374
Operational Systems Development	16,615,291	18,770,188		18,954,548	18,919,248	220,241	19,139,489
Total Research, Development, Test & Eval, AF	26,691,777	27,98 <b>1</b> ,721	187,651	28,169,372	27,247,302	266,241	27,513,543
Summary Recap of FYDP Programs							
Strategic Forces	85,534	731,044		731,044	500,974		500,974
General Purpose Forces	2,315,375	2,467,564		2,467,564	2,542,733	4,443	2,547,176
Intelligence and Communications	2,372,609	2,804,119		2,804,119	2,972,917	6,100	2,979,017
Mobility Forces	563,770	524,219		524,219	544,547	10,325	554,872
Research and Development	9,312,534	8,936,341	3,291	8,939,632	7,938,100	46,000	7,984,100
Central Supply and Maintenance	277,356	312,881		312,881	260,237		260,237
Training Medical and Other	7,443	7,360		7,360	2,336		2,336
Administration and Associated Activities	65,903	106,410		106,410	74,913		74,913
Support of Other Nations	3,789	3,748		3,748	3,764		3,764
Classified Programs	11,687,464	12,088,035	184,360	12,272,395	12,406,781	199,373	12,606,154
Total Research, Development, Test & Eval, AF	26,691,777	27,981,721	187,651	28,169,372	27,247,302	266,241	27,513,543

Exhibit R-1G: FY 2011 President's Budget (Published), as of January 20, 2010 at 14:07:17

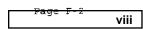


#### Department of the Air Force FY 2011 President's Budget Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request (Dollars in Thousands)

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

S FY 2010 FY 2010 Program FY 2011 FY 2011 е FY 2011 FY 2009 Base & OCO Supplemental FY 2010 Element Line 0CO Total Request c Total Base Number (Base & OCO) Enacted Request No Item Act \_\_\_\_\_ - - - - - - - - - **- - -** - -. . . . . . . . . . . . ----------- - - -- - -U 328,471 350,978 350,978 0601102F Defense Research Sciences 01 299,830 328,471 1 136,297 U 141,524 136,297 0601103F University Research 01 133,526 141,524 2 Initiatives 13,198 U 12,781 12,781 13,198 13,032 3 0601108F High Energy Laser 01 Research Initiatives . . . . . . . . . . \_\_\_\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ 482,776 500,473 500,473 446,388 482,776 Basic Research 137,273 U 179,202 137,273 0602102F Materials 02 185,583 179,202 4 144,699 U 138,563 144,699 0602201F Aerospace Vehicle 02 119,544 138,563 5 Technologies 87,452 U 87,452 93,954 93,527 93,527 0602202F Human Effectiveness 02 6 Applied Research TT 207,049 221,503 221,503 207,049 244,890 7 0602203F Aerospace Propulsion 02 157,497 Ŭ 136,012 157,497 0602204F Aerospace Sensors 02 130,902 136,012 8 111,857 U 111,857 119,125 119,125 9 0602601F Space Technology 02 136,072 58,044 61,330 61,330 11 0602602F Conventional Munitions 02 56,596 58,044 10 103,596 U 105,231 105.231 103,596 Directed Energy 02 60,233 11 0602605F Technology U 0602702F Command Control and 02 114,510 12 Communications 117,283 U 117,283 116,785 116,785 13 0602788F Dominant Information 02 Sciences and Methods 53,384 Ŭ 53,229 53.384 53,229 High Energy Laser 02 47,939 7.4 0602890F Research \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ ----------1,181,420 1,181,420 1,221,221 1.190.223 1,221,221 Applied Research 33,414 U 67,856 33,414 67,856 Advanced Materials for СЗ 62,070 15 0603112F Weapon Systems

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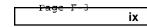
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#### Department of the Air Force FY 2011 President's Budget Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request (Dollars in Thousands)

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

Date: 20 Jan 2010

Line No	Program Element Number	Item	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	5 e c
16	0603199F	Sustainment Science and Technology (S&T)	03		2,943		2,943	2,935		2,935	U
17	0603203F	Advanced Aerospace Sensors	03	69,902	52,786		52,786	44,677		44,677	U
18	C603211F	Aerospace Technology Dev/ Demo	03	41,748	88,226		88,226	53,588		53,588	U
19	0603216F	Aerospace Propulsion and Power Technology	03	175,292	192,241		192,241	136,135		136,135	U
20	0603231F	Crew Systems and Personnel Protection Technology	03	35,742							U
21	0603270F	Electronic Combat Technology	03	29,364	32,056		32,056	16,992		16,992	υ
22	0603401F	Advanced Spacecraft Technology	03	97,834	98,708		98,708	83,705		83,705	U
23	0603444F	Maui Space Surveillance System (MSSS)	03	36,093	36,661		36,661	5,899		5,899	U
24	0603456F	Human Effectiveness Advanced Technology Development	03		27,390		27,390	24,814		24,814	U
25	0603601F	Conventional Weapons Technology	03	16,771	14,296		14,296	15,755		15,755	U
26	0603605F	Advanced Weapons Technology	03	61,420	44,794		44,79 <b>4</b>	17,461		17,461	U
27	C6C3680F	Manufacturing Technology Program	СЗ	54,614	50,502		50,502	39,701		39,701	υ
28	0603788F	Battlespace Knowledge Development and Demonstration	03		46,414		46,414	32,382		32,382	U
29	0603789F	C3I Advanced Development	03	32,986							U



## Department of the Air Force FY 2011 President's Budget Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request (Dollars in Thousands)

Appro	priation: 3	600F Research, Development,	Test	& Eval, AF						Date: 20 Jan 20	010
Line No	Program Element Number	Item	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	S e c
30	06C3924F	High Energy Laser Advanced Technology Program	03	3,899	3,794		3,794	1,847		1,847	U
	Advanc	ed Technology Development		717,735	758,667		758,667	509,305		509,305	
31	0603260F	Intelligence Advanced Development	C 4	6,570	5,809		5,809	5,019		5,019	U
32	0603287F	Physical Security Equipment	04	1,659	3,615		3,615	3,576		3,576	U
33	0603423F	Global Positioning System III - Operational Control Segment	04	289,702							U
34	0603430F	Advanced EHF MILSATCOM (SPACE)	04	460,351	461,380		461,380	351,817		351,817	U
35	0603432F	Polar MILSATCOM (SPACE)	04	221,065	252,071		252,071	164,232		164,232	U
36	0603438F	Space Control Technology	04	86,110	100,951		100,951	45,012	16,000	61,012	ប
37	0603742F	Combat Identification Technology	04	28,708	28,799		28,799	26,172		26,172	U
38	06C3790F	NATO Research and Development	C4	4,241	4,351		4,351	4,372		4,372	υ
39	0603791F	International Space Cooperative R&D	04	603	632		632	635		635	U
40	C6C383CF	Space Protection Program (SPP)	C4					8,349		8,349	υ
41	C603845F	Transformational SATCOM (TSAT)	C 4	428,618							U
42	C603850F	Integrated Broadcast Service	C4	21,620	20,646		20,646	20,580		20,580	υ
43	06C3851F	Intercontinental Ballistic Missile	64	58,937	68,097		68,097	66,745		66,745	U

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#### Department of the Air Force FY 2011 President's Budget Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request (Dollars in Thousands)

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Date: 20 Jan 2010

Line No	Program Element Number	Item	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	s e c
44	06C3854F	Wideband Global SATCOM RDT&E (Space)	04	29,520	70,650		70,650	36,123		36,123	U
45	0603859F	Pollution Prevention	04	13,565	10,396		10,396	2,534		2,534	U
46	0603860F	Joint Precision Approach and Landing Systems	04	7,153	22,953		22,953	13,952		13,952	U
47	0604C15F	Next Generation Bomber	04					198,957		198,957	U
48	0604283F	Battle Mgmt Com & Ctrl Sensor Development	04		22,612		22,612				U
49	0604327F	Hard and Deeply Buried Target Defeat System (HDBTDS) Program	04	28,310	20,891		20,891	22,389		22,389	U
50	0604330F	Joint Dual Role Air Dominance Missile	04		6,882		6,882	9,799		9,799	U
51	0604337F	Requirements Analysis and Maturation	04		35,533		35,533	34,339		34,339	U
52	0604436F	Next-Generation MILSATCOM Technology Development	04		50,000		50,000				ប
53	C604635F	Ground Attack Weapons Fuze Development	04		18,778		18,778	32,513		32,513	U
54	0604796F	Alternative Fuels	04	30,283	73,020		73,020	24,064		24,064	U
55	0604830F	Automated Air-to-Air Refueling	04	9,610	43,158		43,158	85		85	U
56	06C4857F	Operationally Responsive Space	04	228,540	124,308		124,308	93,978		93,978	υ
57	0604858F	Tech Transition Program	04		9,611		9,611	12,260		12,260	ບ



#### Department of the Air Force FY 2011 President's Budget Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request (Dollars in Thousands)

Appro	priation: 3	600F Research, Development,	Test	& Eval, AF						Date: 20 Jan 20	)10
Line No	Program Element Number	Item	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	S e c -
58	0305178F	National Polar-Orbiting Operational Environmental Satellite System (NPOESS)	04	287,532	386,611		386,611	325,505		325,505	υ
	Advanc	ed Component Development &	Prot	2,242,097	1,841,754		1,841,754	1,503,007	16,000	1,519,007	
59	0603840F	Global Broadcast Service (GBS)	05	17,475	31,072		31,072	18,171		18,171	υ
60	0604222F	Nuclear Weapons Support	05	19,845	41,860		41,860	60,545		60,545	U
61	0604226F	B-1B	05	158,081							U
62	0604233F	Specialized Undergraduate Flight Training	05	11,801	10,862		10,862	8,066		8,066	U
63	C60424CF	B-2 Advanced Technology Bomber	05	384,190							υ
64	0604270F	Electronic Warfare Development	05	66,321	80,275		80,275	89,966		89,966	U
65	0604280F	Joint Tactical Radio	05					631		631	U
66	0604281F	Tactical Data Networks Enterprise	05		87,444		87,444	102,941	30,000	132,941	U
67	C604287F	Physical Security Equipment	05	51	50		50	50		50	U
68	0604329F	Small Diameter Bomb (SDB)	05	122,568	155,415		155,415	153,505		153,505	U
69	0604421F	Counterspace Systems	05	64,318	63,838		63,838	40,276		40,276	U
70	0604425F	Space Situation Awareness Systems	05	211,266	238,377		238,377	426,525		426,525	U
71	C604429F	Airborne Electronic Attack	05	42,173	11,107		11,107	25,937		25,937	ប

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#### Department of the Air Force FY 2011 President's Budget Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request (Dollars in Thousands)

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

Date: 20 Jan 2010

Line No 	Program Element Number	Item	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	S e c
72	0604441F	Space Based Infrared System (SBIRS) High EMD	05	542,404	521,156		521,156	530,047		530,047	υ
73	0604443F	Third Generation Infrared Surveillance (3GIRS)	05	953	73,369		73,369				U
74	0604602F	Armament/Ordnance Development	05	12,088	18,671		18,671	6,693		6,693	U
75	0604604F	Submunitions	05	1,719	1,784		1,784	1,622		1,622	U
76	0604617F	Agile Combat Support	05	4,518	11,261		11,261	37,987		37,987	U
77	0604706F	Life Support Systems	05	14,907	14,331		14,331	10,650		10,650	U
78	06C4735F	Combat Training Ranges	05	12,241	22,718		22,718	36,905		36,905	U
79	06C4740F	Integrated Command & Control Applications (IC2A)	05	9,700	6,910		6,910	10		10	U
80	0604750F	Intelligence Equipment	05	2,282	1,495		1,495	1,364		1,364	U
81	06048C0F	Joint Strike Fighter (JSF)	05	1,743,569	2,072,897		2,072,897	883,773		883,773	U
82	0604851F	Intercontinental Ballistic Missile	C5		60,010		60,010	71,843		71,843	U
83	C604853F	Evolved Expendable Launch Vehicle Program (SPACE)	0.5	43,628	46,545		46,545	30,245		30,245	U
84	0605011F	RDT&E for Aging Aircraft	05	5,808							U
85	0605221F	Next Generation Aerial Refueling Aircraft	05	22,629	15,000		15,000	863,875		863,875	U
86	C6C5229F	CSAR HH-60 Recapitalization	05					12,584		12,584	U
87	C605277F	CSAR-X RDT&E	05	15,000	14,975		14,975				U

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Line No	Program Element Number	Item 	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	S e C
88	0605278F	HC/MC-130 Recap RDT&E	05	11,336	20,582		20,582	15,536		15,536	U
89	0605452F	Joint SIAP Executive Program Office	05		14,877		14,877				U
90	C2C7434F	Link-16 Support and Sustainment	05	278,961	65,619		65,619				U
91	0207451F	Single Integrated Air Picture (SIAP)	05	49,564	13,399		13,399	1,832		1,832	U
92	0207701F	Full Combat Mission Training	05	77,362	79,807		79,807	57,393		57,393	υ
93	0305176F	Combat Survivor Evader Locator	05	12,500							U
94	0401138F	Joint Cargo Aircraft (JCA)	05	16,271	9,353		9,353	26,407		26,407	U
95	0401318F	CV-22	05	17,992	19,640		19,640	18,270		18,270	U
96	0401845F	Airborne Senior Leader C3 (SLC3S)	05	1,906	19,976		19,976	15,826		15,826	υ
	System	Development & Demonstratic	on	3,995,427	3,844,675	· · · ·	3,844,675	3,549,475	30,000	3,579,475	
97	06C4256F	Threat Simulator Development	06	33,951	23,331		23,331	21,245		21,245	υ
98	0604759F	Major T&E Investment	06	67,898	67,797		67,797	61,587		61,587	U
99	0605101F	RAND Project Air Force	06	37,674	29,101		29,101	26,752		26,752	U
100	0605502F	Small Business Innovation Research	06	375,035							υ
101	0605712F	Initial Operational Test & Evaluation	06	29,085	25,833		25,833	20,665		20,665	U
102	0605807F	Test and Evaluation Support	06	756,327	746,465	3,291	749,756	759,868		759,868	5

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#### Appropriation: 3600F Research, Development, Test & Eval, AF

Date: 20 Jan 2010

Line No	Program Element Number	Item 	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	S e c
103	0605860F	Rocket Systems Launch Program (SPACE)	06	16,853	14,637		14,637	23,551		23,551	U
104	C605864F	Space Test Program (STP)	06	44,707	46,721		46,721	47,623		47,623	υ
105	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support	06	47,339	54,809		54,809	46,327		46,327	U
106	0605978F	Facilities Sustainment - Test and Evaluation Support	06	29,618	29,683		29,683	27,579		27,579	U
107	0606323F	Multi-Service Systems Engineering Initiative	06					18,901		18,901	υ
108	0702806F	Acquisition and Management Support	06	41,053	18,865		18,865	24,968		24,968	U
109	0804731F	General Skill Training	06	1,215	1,450		1,450	1,544		1,544	U
110	0909999F	Financing for Cancelled Account Adjustments	06	72							υ
111	1001004F	International Activities	06	3,789	3,748	<b></b>	3,748	3,764		3,764	U
	RDT&E	Management Support		1,484,616	1,062,440	3,291	1,065,731	1,084,374		1,084,374	
112	0603423F	Global Positioning System III - Operational Control Segment	07		292,000		292,000				บ
113	0604263F	Common Vertical Lift Support Platform	07	3,858	4,000		4,000				U
114	0605018F	Air Force Integrated Military Human Resources System :AF-IMHRS)	07					43,300		43,300	U
115	0605024F	Anti-Tamper Technology Executive Agency	07	20,407	47,27 <b>6</b>		47,276	42,255		42,255	υ
117	0101113F	B-52 Squadrons	07	39,835	102,330		102,330	146,096		146,096	ΰ

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#### Department of the Air Force FY 2011 President's Budget Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request (Dollars in Thousands)

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

Date: 20 Jan 2010

Line No	Program Element Number	Item	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	S e c
	0101122F	Air-Launched Cruise Missile (ALCM)	07	384	3,652		3,652	3,631		3,631	U
119	C101126F	B-1B Squadrons	07		143,360		143,360	33,234		33,234	U
120	0101127F	B-2 Squadrons	07		407,189		407,189	260,466		260,466	U
121	0101313F	Strat War Planning System - USSTRATCOM	07	17,013	33,746		33,746	28,441		28,441	U
122	0101314F	Night Fist - USSTRATCOM	07	5,136	5,328		5,328	5,359		5,359	U
124	0102325F	Atmospheric Early Warning System	07		9,832		9,832				υ
125	0102326F	Region/Sector Operation Control Center Modernization Program	07	23,151	25,589		25,589	23,732		23,732	U
126	0102823F	Strategic Aerospace Intelligence System Activities	07	15	18		18	15		15	U
127	0203761F	Warfighter Rapid Acquisition Process (WRAP) Rapid Transition Fund	07	29,928	11,968		11,968	10,580		10,580	U
128	0205219F	MQ-9 UAV	07	57,205	93,145		93,145	125,427		125,427	U
129	02C7040F	Multi-Platform Electronic Warfare Equipment	07		14,747		14,747	15,574		15,574	υ
130	0207131F	A-10 Squadrons	07	3,989	12,197		12,197	5,661		5,661	υ
131	C207133F	F-16 Squadrons	07	123,733	142,620		142,620	129,103		129,103	U
132	0207134F	F-15E Squadrons	07	203,816	319,967		319,967	222,677		222,677	U
133	C207136F	Manned Destructive Suppression	07	5,413	9,748		9,748	12,937		12,937	υ

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#### Department of the Air Force FY 2011 President's Budget Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request (Dollars in Thousands)

#### Appropriation: 3600F Research, Development, Test & Eval, AF

Date: 20 Jan 2010

Line No	Program Element Number	Item 	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 0CO	FY 2011 Total Request	S e c
134	0207138F	F-22A Squadrons	07	579,710	569,345		569,345	576,330		576,330	υ
135	0207142F	F-35 Squadrons	07					217,561		217,561	υ
136	0207161F	Tactical AIM Missiles	07	5,585	5,915		5,915	6,040		6,040	ប
137	0207163F	Advanced Medium Range Air-to-Air Missile (AMRAAM)	67	43,633	49,971		49,971	62,922		62,922	U
138	0207170F	Joint Helmet Mounted Cueing System (JHMCS)	07	3,095	2,529		2,529	2,407		2,407	U
139	0207224F	Combat Rescue and Recovery	07					944		944	U
140	0207227F	Combat Rescue - Pararescue	07		2,950		2,950	2,921		2,921	U
141	0207247F	AF TENCAP	07	11,547	11,643		11,643	11,648		11,648	U
142	C2C7249F	Precision Attack Systems Procurement	07		2,950		2,950	3,017		3,017	U
143	0207253F	Compass Call	07	4,526	13,019		13,019	20,652		20,652	U
144	0207268F	Aircraft Engine Component Improvement Program	07	146,359	139,68 <del>9</del>		139,689	147,396		147,396	υ
145	0207277F	ISR Innovations	07		11,261		11,261				υ
146	0207325F	Joint Air-to-Surface Standoff Missile (JASSM)	C7	32,131	29,494		29,494	20,000		20,000	U
147	0207410F	Air & Space Operations Center (AOC)	C7	95,908	101,587		101,587	93,102		93,102	υ
148	0207412F	Control and Reporting Center (CRC)	C7	18,688	52,177		52,177	58,313		58,313	τ
149	0207417F	Airborne Warning and Control System (AWACS)	67	122,425	175,514		175,514	239,755		239,755	U

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#### Department of the Air Force FY 2011 President's Budget Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request (Dollars in Thousands)

Appropriation:	3600F	Research,	Development,	Test	Sc.	Eval.	AF
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Date: 20 Jan 2010

Line No	Program Element Number	Item	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	S e c -
150	0207418F	Tactical Airborne Control Systems	07	l,486							U
151	0207423F	Advanced Communications Systems	07	28,210	73,009		73,009	67,532		67,532	υ
153	0207431F	Combat Air Intelligence System Activities	07		1,475		1,475	3,310		3,310	U
154	0207438F	Theater Battle Management (TBM) C4I	07	18,845	19,033		19,033	15,170		15,170	U
155	0207445F	Fighter Tactical Data Link	07	55,069	66,872		66,872	85,492		85,492	υ
156	0207446F	Bomber Tactical Data Link	07	21,603							U
157	0207448F	C2ISR Tactical Data Link	07	1,671	1,659		1,659	1,584		1,584	U
158	0207449F	Command and Control (C2) Constellation	07	30,832	30,293		30,293	24,229		24, <b>22</b> 9	U
159	0207581F	Joint Surveillance/ Target Attack Radar System (JSTARS)	07	97,625	185,616		185,616	168,917		168,917	υ
160	0207590F	Seek Eagle	07	21,355	22,071		22,071	19,263		19,263	U
161	0207601F	USAF Modeling and Simulation	07	28,062	27,161		27,161	21,638		21,638	U
162	0207605F	Wargaming and Simulation Centers	07	3,752	7,018		7,018	6,020		6,020	U
163	0207697F	Distributed Training and Exercises	07	6,918	6,740		6,740	2,863		2,863	U
164	0208CC6F	Mission Planning Systems	67	94,589	81,577		81,577	79,112	4,443	83,555	U
165	0208C21F	Information Warfare Support	07	11,780	13,779		13,779	2,294		2,294	U
166	C208059F	Cyber Command Activities	07					1,117		1,117	U

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173	C3C1400F	Space Superiority Intelligence	07					10,006		10,006	υ
174	0302015F	E-4B National Airborne Operations Center (NAOC)	07	158	26,107		26,107	12,532		12,532	U
175	0303131F	Minimum Essential Emergency Communications Network (MEECN)	07	81,095	72,360		72,360	78,784		78,784	υ
176	0303140F	Information Systems Security Program	07	162,815	165,401		165,401	140,017		140,017	U
177	0303141F	Global Combat Support System	07	8,613	3,319		3,319	3,393		3,393	U
178	0303150F	Global Command and Control System	07	3,124	6,279		6,279	3,055		3,055	U
179	0303158F	Joint Command and Control Program (JC2)	07	3,140				2,157		2,157	U
180	0303601F	MILSATCOM Terminals	07	277,501	253,818		253,818	186,582		186,582	U
182	0304260F	Airborne SIGINT Enterprise	07	170,714	166,989		166,989	149,268		149,268	U
185	0305099F	Global Air Traffic Management (GATM)	07	10,584	5,654		5,654	5,708		5,708	U
186	0305103F	Cyber Security Initiative	07	2,020	2,065		2,065	2,030		2,030	υ
187	0305105F	DoD Cyber Crime Center	07					279		279	U
188	0305110F	Satellite Control Network (SPACE)	07	54,547	20,825		20,825	21,667		21,667	U
189	0305111F	Weather Service	07	45,918	33,291		33,291	32,373		32,373	υ
190	C305114F	Air Traffic Control, Approach, and Landing System (ATCALS)	07	8,796	11,313		11,313	33,268		33,268	U

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191	0305116F	Aerial Targets	07	10,970	54,807		54,807	63,573		63,573	U
194	0305128F	Security and Investigative Activities	07	1,962	742		742	469		469	U
196	0305146F	Defense Joint Counterintelligence Activities	07	39	39		39	40		40	U
198	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	07	121,798	137,163		137,163	165,936		165,936	U
199	0305165F	NAVSTAR Global Positioning System (Space and Control Segments)	07	86,648	51,197		51,197	34,471		34,471	U
201	0305173F	Space and Missile Test and Evaluation Center	07	1,920	3,593		3,593	4,572		4,572	U
202	0305174F	Space Warfare Center	07	2,890	2,961		2,961	2,929		2,929	U
203	0305182F	Spacelift Range System (SPACE)	67	13,322	9,915		9,915	9,933		9,933	U
204	0305193F	Intelligence Support to Information Operations (IO)	07	3,627	2,240		2,240	1,254		1,254	υ
205	0305205F	Endurance Unmanned Aerial Vehicles	07		48,736		48,736				U
206	0305206F	Airborne Reconnaissance Systems	07	111,170	145,413		145,413	168,963		168,963	U
207	0305207F	Manned Reconnaissance Systems	07	17,811	14,846		<b>1</b> 4,846	15,337		15,337	U
208	030520 <b>8F</b>	Distributed Common Ground/Surface Systems	07	75,251	82,404		82,404	93,398		93,398	U
209	0305219F	MQ-1 Predator A UAV	07	38,605	35,160		35,160	28,913		28,913	Ξ

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Line No	Program Element Number	Item	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	5 e -
210	0305220F	RQ-4 UAV	07	279,164	317,268		317,268	251,318		251,318	U
211	0305221F	Network-Centric Collaborative Targeting	07	8,783	8,160		8,160	7,267	6,100	13,367	U
212	0305265F	GPS III Space Segment	07	379,046	423,466		423,466	828,171		828,171	U
213	0305614F	JSpOC Mission System	07		136,271		136,271	132,706		132,706	U
214	0305887F	Intelligence Support to Information Warfare	07	5,251	5,220		5,220	5,512		5,512	U
215	0305913F	NUDET Detection System (SPACE)	07	41,102	83,846		83,846	72,199		72,199	υ
216	0305924F	National Security Space Office	07	7,512				10,630		10,630	U
217	0305940F	Space Situation Awareness Operations	07	15,579	53,805		53,805	43,838		43,838	U
218	0307141F	Information Operations Technology Integration & Tool Development	07	18,042	29,788		29,788	21,912		21,912	U
219	0308699F	Shared Early Warning (SEW)	07	3,060	3,047		3,047	2,952		2,952	υ
220	0401115F	C-130 Airlift Squadron	07	156,010	109,250		109,250	113,107		113,107	U
221	0401119F	C-5 Airlift Squadrons (IF)	07	110,191	85,266		85,266	58,990		58,990	υ
222	0401130F	C-17 Aircraft (IF)	07	182,754	161,855		161,855	177,212		177,212	U
223	0401132F	C-130J Program	07	25,190	30,019		30,019	26,770		26,770	υ
224	0401134F	Large Aircraft IR Countermeasures (LAIRCM)	07	22,490	26,784		26,784	17,227		17,227	υ
225	C401218F	KC-135s	07	11, <b>9</b> 17	10,220		10,220	20,453		20,453	U
226	0401219F	KC-10s	07	3,800	35,586		35,586	56,669		56,669	υ

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Line No	Program Element Number	Item	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	S e C
227	0401314F	Operational Support Airlift	07		4,916		4,916	4,988		4,988	U
228	0401315F	C-STOL Aircraft	07					1,283		1,283	U
22 <u>9</u>	C401839F	Air Mobility Tactical Data Link	07	7,700							U
230	0408011F	Special Tactics / Combat Control	07	7,549	11,354		11,354	7,345	10,325	17,670	υ
231	0702207F	Depot Maintenance (Non-IF)	07	1,489	1,508		1,508	1,514		1,514	U
232	0702976F	Facilities Restoration & Modernization - Logistics	07	44,778	8,000		8,000				U
233	0708012F	Logistics Support Activities	07	23,042							U
234	0708610F	Logistics Information Technology (LOGIT)	07	144,861	246,250		246,250	227,614		227,614	υ
235	0708611F	Support Systems Development	07	22,133	38,258		38,258	6,141		6,141	U
236	0804743F	Other Flight Training	07	2,000	805		805	667		667	U
237	0804757F	Joint National Training Center	07	3,115	3,220		3,220	9		9	υ
23.8	0804772F	Training Developments	07		1,769		1,769				U
239	0808716F	Other Personnel Activities	07	1,113	116		116	116		116	U
240	0901202F	Joint Personnel Recovery Agency	07	5,590	11,376		11,376	6,107		6,107	U
241	0901212F	Service-Wide Support (Not Otherwise Accounted For)	<b>C</b> 7	3,648							U

#### Department of the Air Force FY 2011 President's Budget Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request (Dollars in Thousands)

#### Appropriation: 3600F Research, Development, Test & Eval, AF

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242	0901218F	Civilian Compensation Program	07	14,647	8,174		8,174	7,811		7,811	υ
243	0901220F	Personnel Administration	07	18,947	30,969		30,969	11,179		11,179	U
244	0901538F	Financial Management Information Systems Development	07	22,999	55,891		55,891	49,816		49,816	U
9999	999999999999	Classified Programs		11,687,464	12,088,035	184,360	12,272,395	12,406,781	199,373	12,606,154	U
	Operati	onal Systems Development		16,615,291	18,770,188		18,954,548	18,919,248	220,241	19,139,489	
Total	Research, D	evelopment, Test & Eval, A	γF	26,691,777	27,981,721	187,651	28,169,372	27,247,302	266,241	27,513,543	

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## Budget Activity 02: Applied Research

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16	03	0603199F	Sustainment Science and Technology (S&T)Volume 1 - 473
17	03	0603203F	Advanced Aerospace Sensors
18	03	0603211F	Aerospace Technology Dev/Demo
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21	03	0603270F	Electronic Combat TechnologyVolume 1 - 583
22	03	0603401F	Advanced Spacecraft Technology
23	03	0603444F	MAUI SPACE SURVEILLANCE SYSTEM

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### Budget Activity 03: Advanced Technology Development (ATD)

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## Budget Activity 04: Advanced Component Development & Prototypes (ACD&P)

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62	05	0604233F	Specialized Undergraduate Pilot Training
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PREDATOR DEVELOPMENT/FIELDING	0305219F	209	07Volume 3 - 1131
RAND Project Air Force	0605101F	99	06Volume 2 - 1053

# Air Force • President's Budget FY 2011 • RDT&E Program

Program Element Title	Program Element Number	Line Item	Budget Activity Page
RDT&E For Aging Aircraft	0605011F	84	05Volume 2 - 855
REGION/ SECTOR OPERATIONS CONTROL CENTER	0102326F	125	07Volume 3 - 129
Requirements Analysis and Maturation	0604337F	51	04Volume 2 - 309
Rocket Systems Launch Program (RSLP)	0605860F	103	06Volume 2 - 1083
Satellite Control Network	0305110F	188	07Volume 3 - 925
Security And Investigative Activities	0305128F	194	07Volume 3 - 975
Seek Eagle	0207590F	160	07Volume 3 - 615
SERVICE-WIDE SUPPORT	0901212F	241	07Volume 3 - 1557
Shared Early Warning System	0308699F	219	07Volume 3 - 1281
Single Integrated Air Picture (SIAP)	0207451F	91	05Volume 2 - 943
SLC3S-A (Senior Leader C3S)	0401845F	96	05Volume 2 - 1021
Small Diameter Bomb	0604329F	68	05Volume 2 - 575
Space & Missile Test & Evaluation Center	0305173F	201	07Volume 3 - 1011
Space Based Infrared Systems (SBIRS) High EMD	0604441F	72	05Volume 2 - 673
Space Control Technology	0603438F	36	04Volume 2 - 71
Spacelift Range System	0305182F	203	07Volume 3 - 1029
Space Protection Program	0603830F	40	04Volume 2 - 165
Space Situation Awareness Operations	0305940F	217	07Volume 3 - 1255
Space Situation Awareness Systems	0604425F	70	05Volume 2 - 613
SPACE SUPERIORITY INTELLIGENCE	0301400F	173	07Volume 3 - 717

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# Air Force • President's Budget FY 2011 • RDT&E Program

Program Element Title	Program Element Number	Line Item	Budget Activity Page
Space Technology	0602601F	09	02Volume 1 - 317
Space Test Program	0605864F	104	06Volume 2 - 1091
SPACE WARFARE CENTER	0305174F	202	07Volume 3 - 1021
Specialized Undergraduate Pilot Training	0604233F	62	05Volume 2 - 473
SPECIAL TACTICS/COMBAT CONTROL	0408011F	230	07Volume 3 - 1439
STRAT AEROSPACE INTEL SYS ACTIVITIES	0102823F	126	07Volume 3 - 139
STRAT WAR PLANNING SYS - USSTRATCOM	0101313F	121	07Volume 3 - 91
Submunitions	0604604F	75	05Volume 2 - 721
Support Systems Development	0708611F	235	07Volume 3 - 1485
Sustainment Science and Technology (S&T)	0603199F	16	03Volume 1 - 473
TAC AIRBORNE CONTROL SYSTEM	0207418F	150	07Volume 3 - 485
Tactical AIM Missiles	0207161F	136	07Volume 3 - 269
TACTICAL DATA NETWORKS ENTERPRISE	0604281F	66	05Volume 2 - 543
Technology Transition Program.	0604858F	57	04Volume 2 - 395
Test and Evaluation Support	0605807F	102	06Volume 2 - 1073
Theater Battle Management (TBM) C4I	0207438F	154	07Volume 3 - 527
Third Generation Infrared Surveillance (3GIRS)	0604443F	73	05Volume 2 - 689
Threat Simulator Development	0604256F	97	06Volume 2 - 1031
TRAINING DEVELOPMENTS	0804772F	238	07Volume 3 - 1533
Transformational SATCOM (TSAT)	0603845F	41	04Volume 2 - 175

# Air Force • President's Budget FY 2011 • RDT&E Program

Program Element Title	Program Element Number	Line Item	Budget Activity Page
University Research Initiatives	0601103F	02	01Volume 1 - 73
USAF Modeling and Simulation	0207601F	161	07Volume 3 - 627
Warfighter Rapid Acquisition Program	0203761F	127	07Volume 3 - 147
Wargaming and Simulation Centers	0207605F	162	07Volume 3 - 653
WEATHER SERVICE	0305111F	189	07Volume 3 - 935
Wideband MILSATCOM (Space)	0603854F	44	04Volume 2 - 233
WWMCCS/GLOBAL COMMAND & CONTROL SYSTEM	0303150F	178	07Volume 3 - 825

PROGRAM ELEMENT COMPARISON SUMMARY				
PROGRAM ELEMENT (By BUDGET ACTIVITY)				
BUDGET ACTIVITY #1: BASIC RESEARCH (Vo	lume 1)	REMARKS		
BUDGET ACTIVITY #2: APPLIED RESEARCH	(Volume 1)			
0602601F	Space Technology	In FY 2011, increases in funding are due the movement of technologies from PE 0603401F, Advanced Spacecraft Technology, to this PE in order to better align the technology readiness levels of these efforts.		
BUDGET ACTIVITY #3: ADVANCED TECHNOL	OGY DEVELOPMENT (Volume 1)			
0603401F	Advanced Spacecraft Technology	In FY 2011, Changes in funding are due to some technology development efforts being moved to PE 0602601F, Space Technology, in order to better align the technology readiness levels of these efforts. In FY 2011, The funding in this project 63681B decreases due to planned taper of turbine engine		
0603216F	Aerospace Propulsion and Power Technology	technologies.		
0603112F	Advanced Materials for Weapon Systems	In FY 2011, funds from Project 2100 have been moved to Program Element 0602102F BPAC 4348 to increase emphasis on applied research.		
BUDGET ACTIVITY #4: ADVANCED COMPONE	ENT DEVELOPMENT AND PROTOTYPE (Volume 2)			
0603438F 0604015F	Space Control Technology Long Range Strike and Industrial Base	In FY 2011 OCO requested, \$16.000M, replaces and upgrades equipment left with Army and Air Force counterspace units in Operation Iraqi Freedom (OIF). This technology was developed by the Rapid Reaction Squadron in response to numerous warfighter Urgent Operational Needs (UONs) and Joint Urgent Operational Needs (JUONs) for OIF. In FY 2011 PE 0604015F is a new start effort.		
0603830F	Space Protection Program	In FY 2011, new Program Element 0306830F. All Space Protection Program funding and content were transferred from PE 0630438F, Space Control Technology, and PE 0305940F, Space Situational Awareness, in FY 2011.		
BUDGET ACTIVITY #5: SYSTEM DEVELOPME	NT AND DEMONSTRATION (SDD) (Volume 2)			
0604706F	Life Support Systems	In FY 2011, Project 65412A, Life Support Systems, includes new starts for flash blindness goggles and aircrew flight equipment.		
0604281F	TACTICAL DATA NETWORKS ENTERPRISE	In FY 2011 funding totals include \$30M requested for Overseas Contingency Operations.		
0605221F	KC-X, Next Generation Aerial Refueling Aircraft	In FY 2011 PB restructures the KC-X budget to account for the fact-of-life delays for the recompetition and planned summer 2010 contract award.		
BUDGET ACTIVITY #6: RDT&E MANAGEMENT	SUPPORT (Volume 2)			
0606323F	Multi-Service Systems Engineering	In FY 2011, this is a new PE. In FY 2010, PE 0605452F Joint Single Integrated Air Picture (SIAP) Program Executive Office efforts come to a close. This new PE (0606323F) includes follow-on efforts under the Joint Integrated Air and Missile Defense (JIAMD) initiative. FY 2011 efforts in this PE include Multi-Service Systems Engineering (MSSE), Joint Track Manager Capability (JTMC) demonstrations, and Joint Operational requirements definition.		
BUDGET ACTIVITY #7: OPERATIONAL SYSTE	M DEVELOPMENT (Volume 3)			
0208021F	Information Warfare Support	In FY 2011, Electronic Combat Spt, C3 Protection/Multi-Mission, Technology and Spt efforts transferred to PE 0310400F, Space Superiority Intelligence for proper execution in AFSPC.		

#### PROGRAM ELEMENT COMPARISON SUMMARY

#### PROGRAM ELEMENT (By BUDGET ACTIVITY)

#### REMARKS

0208006F 0207268F 0207136F	Mission Planning Systems Aircraft Engine Component Improvement Program (CIP) Manned Destructive Suppression	In FY 2011, Project 673858, Mission Planning Systems, efforts were transferred to PE 0208006F, Mission Planning Systems, Project 675302, Mobility Air Forces Planning Systems (previously titled Precision Aerial Delivery System) and Project 675380, Combat Air Forces Planning Systems, in order to more accurately group and reflect the products being developed within the program. FY 2011 funding totals include \$4.443 for Overseas Contingency Operations (OCO) FY 2011 - Project 675365 is new in FY11 to provide enhanced funds tracking and accountability for Engine CIP support of F-35 propulsion systems. Engine CIP for all other AF aircraft propulsion programs is accomplished within Project 671012. In FY 2011, this effort contains a new start for P3I R7 Study Effort for Next Phase.
0207134F	F-15E SQUADRONS	In FY 2011, the F-15 program has a new start: F-15C/D Advanced Display Core Processor (ADCP+)with Vertical Situation Display to replace obsolete 25 MHz Central Computers.
0305221F	Network Centric Collaborative Targeting	In FY 2011 funding totals include \$6.1M for the Overseas Contigency Operations (OCO) Supplemental Request to develop a Network Centric Collaborative Targeting (NCCT) Core Technology Ground Moving Target Indicator (GMTI) / Signals Intelligence (SIGINT) Correlator. A GMTI / SIGINT correlator for the NCCT fusion engine supports OCO real-time and forensic operations, accelerates High-Side (classified) message architecture to network OCO relevant sensor systems, and directly supports tactics, techniques and procedures (TTP) development for rapid operator use.
0301400F 0207142F 0208021F	Mission Planning Systems Joint Strike Fighter Squadrons Information Warfare Support	In FY 2011, Project Number 670374, Electronic Combat Spt, C3 Protection/Multi-Mission Technology and Spt, funding and content were transferred from PE 0208021F, Information Warfare Support. In FY 2011, PE0207142F is a new PE for Joint Strike Fighter (JSF). PE0604800F is the primary RDT&E funding for JSF. In FY 2011, Electronic Combat Spt, C3 Protection/Multi-Mission, Technology and Spt efforts transferred to PE 0301400F, Space Superiority Intelligence for proper execution in AFSPC.
0408011F	SPECIAL TACTICS/COMBAT CONTROL	In FY 2011 funding totals include \$10.325M requested for Overseas Contingency Operations.
0207268F	Aircraft Engine Component Improvement Program (CIP)	In FY 2011, Project 675365 is new providing enhanced funds tracking and accountability for F-35 propulsion systems. In FY 2011, Project Number 67A051, Space Superiority - Advanced Intelligence Systems content and
0301400F	SPACE SUPERIORITY INTELLIGENCE	funding were transferred from PE 0208021F, Information Warfare Support, in order to focus specific attention on the Space Superiority Intelligence requirements.

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

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# Department of Defense Fiscal Year (FY) 2011 President's Budget

February 2010



# **Air Force**

Justification Book Volume 1

Research, Development, Test & Evaluation, Air Force - 3600

Volume I

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Air Force • President's Budget FY 2011 • RDT&E Program

# **Volume 1 Table of Contents**

Program Element Table of Contents (by Budget Activity then Line Item Number)	Volume 1 - v
Program Element Table of Contents (Alphabetically by Program Element Title)	Volume 1 - ix
Exhibit R-1	Volume 1 - xi
Exhibit R-2's	. Volume 1 - 1

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# Air Force • President's Budget FY 2011 • RDT&E Program

# Program Element Table of Contents (by Budget Activity then Line Item Number)

## Budget Activity 01: Basic Research

Line Item	Budget Activit	y Program Element Number	Program Element Title Page
01	01	0601102F	Defense Research Sciences
02	01	0601103F	University Research Initiatives
03	01	0601108F	High Energy Laser Research Initiatives

## Budget Activity 02: Applied Research

Line Item	Budget Activity	y Program Element Number	Program Element Title Page
04	02	0602102F	Materials
05	02	0602201F	Aerospace Vehicle Technologies Volume 1 - 143
06	02	0602202F	Human Effectiveness Applied Research Volume 1 - 165
07	02	0602203F	Aerospace Propulsion Volume 1 - 205
08	02	0602204F	Aerospace Sensors Volume 1 - 265
09	02	0602601F	Space TechnologyVolume 1 - 317
10	02	0602602F	Conventional Munitions Volume 1 - 347

# Air Force • President's Budget FY 2011 • RDT&E Program

## Budget Activity 02: Applied Research

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
11	02	0602605F	DIRECTED ENERGY TECHNOLOGYVolume 1	- 361
12	02	0602702F	Command Control and CommunicationsVolume 1	- 379
13	02	0602788F	Dominant Information TechnologyVolume 1	- 403
14	02	0602890F	High Energy Laser ResearchVolume 1	- 437

## Budget Activity 03: Advanced Technology Development (ATD)

Line Item	Budget Activity	Program Element Number	Program Element Title Page
15	03	0603112F	Advanced Materials for Weapon Systems Volume 1 - 449
16	03	0603199F	Sustainment Science and Technology (S&T)Volume 1 - 473
17	03	0603203F	Advanced Aerospace Sensors
18	03	0603211F	Aerospace Technology Dev/DemoVolume 1 - 509
19	03	0603216F	Aerospace Propulsion and Power Technology
20	03	0603231F	Crew Systems and Personnel Protection Technology
21	03	0603270F	Electronic Combat TechnologyVolume 1 - 583
22	03	0603401F	Advanced Spacecraft Technology
23	03	0603444F	MAUI SPACE SURVEILLANCE SYSTEM

# Air Force • President's Budget FY 2011 • RDT&E Program

## Budget Activity 03: Advanced Technology Development (ATD)

Line Item	Budget Activity	Program Element Number	Program Element Title Page
24	03	0603456F	Human Effectiveness Adv Tech Dev
25	03	0603601F	Conventional Weapons Technology
26	03	0603605F	Advanced Weapons Technology
27	03	0603680F	Manufacturing Technologies
28	03	0603788F	Global Information Dev/Demo
29	03	0603789F	C3I Advanced DevelopmentVolume 1 - 733
30	03	0603924F	High Energy Laser Advanced Technology Program

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# Air Force • President's Budget FY 2011 • RDT&E Program

# Program Element Table of Contents (Alphabetically by Program Element Title)

Program Element Title	Program Element Number	Line Item	Budget Activity Page
Advanced Aerospace Sensors	0603203F	17	03Volume 1 - 479
Advanced Materials for Weapon Systems	0603112F	15	03Volume 1 - 449
Advanced Spacecraft Technology	0603401F	22	03Volume 1 - 599
Advanced Weapons Technology	0603605F	26	03Volume 1 - 671
Aerospace Propulsion	0602203F	07	02Volume 1 - 205
Aerospace Propulsion and Power Technology	0603216F	19	03Volume 1 - 521
Aerospace Sensors	0602204F	08	02Volume 1 - 265
Aerospace Technology Dev/Demo	0603211F	18	03Volume 1 - 509
Aerospace Vehicle Technologies	0602201F	05	02Volume 1 - 143
C3I Advanced Development	0603789F	29	03Volume 1 - 733
Command Control and Communications	0602702F	12	02Volume 1 - 379
Conventional Munitions	0602602F	10	02Volume 1 - 347
Conventional Weapons Technology	0603601F	25	03Volume 1 - 663
Crew Systems and Personnel Protection Technology	0603231F	20	03Volume 1 - 563
Defense Research Sciences	0601102F	01	01 Volume 1 - 1
DIRECTED ENERGY TECHNOLOGY	0602605F	11	02Volume 1 - 361
Dominant Information Technology	0602788F	13	02Volume 1 - 403

# Air Force • President's Budget FY 2011 • RDT&E Program

Program Element Title	Program Element Number	Line Item	Budget Activity Page
Electronic Combat Technology	0603270F	21	03Volume 1 - 583
Global Information Dev/Demo	0603788F	28	03Volume 1 - 705
High Energy Laser Advanced Technology Program	0603924F	30	03Volume 1 - 749
High Energy Laser Research	0602890F	14	02Volume 1 - 437
High Energy Laser Research Initiatives	0601108F	03	01Volume 1 - 85
Human Effectiveness Adv Tech Dev	0603456F	24	03Volume 1 - 637
Human Effectiveness Applied Research	0602202F	06	02Volume 1 - 165
Manufacturing Technologies	0603680F	27	03Volume 1 - 691
Materials	0602102F	04	02Volume 1 - 93
MAUI SPACE SURVEILLANCE SYSTEM	0603444F	23	03Volume 1 - 631
Space Technology	0602601F	09	02Volume 1 - 317
Sustainment Science and Technology (S&T)	0603199F	16	03Volume 1 - 473
University Research Initiatives	0601103F	02	01Volume 1 - 73

## Air Force • President's Budget FY 2011 • RDT&E Program Exhibit R-1 (Listing by Budget Activity, then Program Element Number)

### **BA# 01: Basic Research**

Line#	BA#	PE#	PE Title	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
01	01	0601102F	Defense Research Sciences	299.830	328.471	350.978	0.000	350.978
02	01	0601103F	University Research Initiatives	133.526	141.524	136.297	0.000	136.297
03	01	0601108F	High Energy Laser Research Initiatives	13.032	12.781	13.198	0.000	13.198
Tota	I: Bas	ic Research	,	446.388	482.776	500.473	0.000	500.473

### **BA# 02: Applied Research**

Line#	BA#	PE#	PE Title	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
04	02	0602102F	Materials	185.583	179.202	137.273	0.000	137.273
05	02	0602201F	Aerospace Vehicle Technologies	119.544	138.563	144.699	0.000	144.699
06	02	0602202F	Human Effectiveness Applied Research	93.954	93.527	87.452	0.000	87.452
07	02	0602203F	Aerospace Propulsion	244.890	221.503	207.049	0.000	207.049
08	02	0602204F	Aerospace Sensors	130.902	136.012	157.497	0.000	157.497
09	02	0602601F	Space Technology	136.072	119.125	111.857	0.000	111.857
10	02	0602602F	Conventional Munitions	56.596	58.044	61.330	0.000	61.330
11	02	0602605F	DIRECTED ENERGY TECHNOLOGY	60.233	105.231	103.596	0.000	103.596

Cost (\$ in Millions)

Cost (\$ in Millions)

# Air Force • President's Budget FY 2011 • RDT&E Program Exhibit R-1 (Listing by Budget Activity, then Program Element Number)

### **BA# 02: Applied Research**

Cost (\$ in Millions)

Line#	BA#	PE#	PE Title	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
12	02	0602702F	Command Control and Communications	114.510	0.000	0.000	0.000	0.000
13	02	0602788F	Dominant Information Technology	0.000	116.785	117.283	0.000	117.283
14	02	0602890F	High Energy Laser Research	47.939	53.229	53.384	0.000	53.384
Tota	Total: Applied Research		1,190.223	1,221.221	1,181.420	0.000	1,181.420	

### BA# 03: Advanced Technology Development (ATD)

				Cost (\$ in Millions)				
Line#	BA#	PE#	PE Title	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
15	03	0603112F	Advanced Materials for Weapon Systems	62.070	67.856	33.414	0.000	33.414
16	03	0603199F	Sustainment Science and Technology (S&T)	0.000	2.943	2.935	0.000	2.935
17	03	0603203F	Advanced Aerospace Sensors	69.902	52.786	44.677	0.000	44.677
18	03	0603211F	Aerospace Technology Dev/Demo	41.748	88.226	53.588	0.000	53.588
19	03	0603216F	Aerospace Propulsion and Power Technology	175.292	192.241	136.135	0.000	136.135
20	03	0603231F	Crew Systems and Personnel Protection Technology	35.742	0.000	0.000	0.000	0.000
21	03	0603270F	Electronic Combat Technology	29.364	32.056	16.992	0.000	16.992
22	03	0603401F	Advanced Spacecraft Technology	97.834	98.708	83.705	0.000	83.705

# Air Force • President's Budget FY 2011 • RDT&E Program Exhibit R-1 (Listing by Budget Activity, then Program Element Number)

### BA# 03: Advanced Technology Development (ATD)

					Cost (\$ in Millions)					
Line#	BA#	PE#	PE Title	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
23	03	0603444F	MAUI SPACE SURVEILLANCE SYSTEM	36.093	36.661	5.899	0.000	5.899		
24	03	0603456F	Human Effectiveness Adv Tech Dev	0.000	27.390	24.814	0.000	24.814		
25	03	0603601F	Conventional Weapons Technology	16.771	14.296	15.755	0.000	15.755		
26	03	0603605F	Advanced Weapons Technology	61.420	44.794	17.461	0.000	17.461		
27	03	0603680F	Manufacturing Technologies	54.614	50.502	39.701	0.000	39.701		
28	03	0603788F	Global Information Dev/Demo	0.000	46.414	32.382	0.000	32.382		
29	03	0603789F	C3I Advanced Development	32.986	0.000	0.000	0.000	0.000		
30	03	0603924F	High Energy Laser Advanced Technology Program	3.899	3.794	1.847	0.000	1.847		
Tota	I: Adv	anced Technology De	evelopment (ATD)	717.735	758.667	509.305	0.000	509.305		

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Exhibit R-2, RDT&E Budget Item	Justification	: PB 2011 A	ir Force						DATE: February 2010						
	<b>APPROPRIATION/BUDGET ACTIVITYR-1 ITEM NO</b> 600: Research, Development, Test & Evaluation, Air ForcePE 0601102F6A 1: Basic ResearchPE 0601102F				•••••••••••••••••••••••••••••••••••••••		ciences								
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost				
Total Program Element	299.830	328.471	350.978	0.000	350.978	339.007	338.984	355.955	373.683	Continuing	Continuing				
612301: <i>Physics</i>	46.896	48.370	50.470	0.000	50.470	47.648	47.498	49.872	52.379	Continuing	Continuing				
612302: Solid Mechanics and Structures	16.921	19.666	20.683	0.000	20.683	19.663	18.848	19.955	20.903	Continuing	Continuing				
612303: Chemistry	36.584	38.957	41.587	0.000	41.587	40.207	38.953	40.459	42.500	Continuing	Continuing				
612304: <i>Mathematics and</i> <i>Computing Sciences</i>	28.707	33.208	37.697	0.000	37.697	36.221	37.258	39.215	41.193	Continuing	Continuing				
612305: Electronics	36.876	40.401	45.066	0.000	45.066	43.056	42.368	44.526	46.763	Continuing	Continuing				
612306: Materials	24.104	29.321	32.040	0.000	32.040	31.134	30.964	32.611	34.225	Continuing	Continuing				
612307: Fluid Mechanics	19.346	25.706	26.800	0.000	26.800	26.226	26.394	27.830	29.182	Continuing	Continuing				
612308: Propulsion	24.669	32.115	34.022	0.000	34.022	32.772	32.599	34.335	36.057	Continuing	Continuing				
612311: Information Sciences	29.698	51.026	53.143	0.000	53.143	52.784	54.630	57.314	60.208	Continuing	Continuing				
612312: Biological Sciences	9.831	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing				
612313: Human Performance	14.319	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing				
614113: External Research Programs Interface	11.879	9.701	9.470	0.000	9.470	9.296	9.472	9.838	10.273	Continuing	Continuing				

#### <u>Note</u>

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.

### 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

xhibit R-2, RDT&E Budget Item Justification: PB 2011.	Air Force			DATE:	February 2010	)
PPROPRIATION/BUDGET ACTIVITY	R-1	ITEM NOMENCL	ATURE			
600: Research, Development, Test & Evaluation, Air Force A 1: Basic Research			e Research Sciences			
the Defense Reliance process to harmonize efforts, elimin						
areas are subject to long-range planning and technical rev Research, because it funds scientific study and experimer		orce and tri-Service	e scientific planning grou	ps. This program is in	n Budget Activi	ty 1, Basic
Program Change Summary (\$ in Millions)						
	FY 2009		FY 2011 Base	FY 2011 OCO	<u>FY 2011</u>	
Previous President's Budget	313.845		0.000	0.000		0.000
Current President's Budget	299.830		350.978	0.000		0.978
Total Adjustments	-14.015	7.443 0.000	350.978	0.000	35	0.978
Congressional General Reductions     Congressional Directed Reductions		0.000				
<ul> <li>Congressional Directed Reductions</li> <li>Congressional Rescissions</li> </ul>	0.000					
Congressional Adds	0.000	8.800				
Congressional Directed Transfers		0.000				
Reprogrammings	0.000					
SBIR/STTR Transfer	0.000					
Other Adjustments	-14.015		350.978	0.000	35	0.978
Congressional Add Details (\$ in Millions, and Inc	ludes General R	eductions)			FY 2009	FY 2010
Project: 612301: Physics						
Congressional Add: Center for Microplasma Scie	ence and Technol	ogy (CMST).		-	1.995	0.00
Congressional Add: Development of Deployable	Biosensors				0.000	1.59
		Con	gressional Add Subtotals	s for Project: 612301	1.995	1.59
Project: 612307: Fluid Mechanics				_		
Congressional Add: <i>Development and Validation</i> Hypersonic Research Center).	of Advanced De	sign Technologies f	or Hypersonic Research	(National	1.995	1.59
		Con	gressional Add Subtotals	s for Project: 612307	1.995	1.59
Project: 612308: Propulsion				-		

it R-2, RDT&E Budget Item Justification: PB 2011 Air Force	e DATE	: February 2010	)
<b>COPRIATION/BUDGET ACTIVITY</b> Research, Development, Test & Evaluation, Air Force Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>		
Congressional Add Details (\$ in Millions, and Includes G	eneral Reductions)	FY 2009	FY 2010
Congressional Add: Coal Transformation Laboratory.		0.798	0.7
	Congressional Add Subtotals for Project: 612308	0.798	0.7
Project: 612311: Information Sciences			
Congressional Add: Process Integrated Mechanism for F	luman-Computer Collaboration and Coordination	0.000	0.7
Congressional Add: Safeguarding End-User military Soft	ware	0.000	3.9
	Congressional Add Subtotals for Project: 612311	0.000	4.7
<u>Change Summary Explanation</u> Note: The FY 2010 President's Budget sumittal did not reflect positions is not provided because it cannot be made in a rele	Congressional Add Totals for all Projects of FY 2011 through FY 2015 funding. A detailed explanation of changes evant manner.		8.7 budget
Note: The FY 2010 President's Budget sumittal did not reflect positions is not provided because it cannot be made in a relevance in FY 2010, Congress added \$0.8 million for Process Safeguarding End-User Military Software, \$0.8 million for Co	ct FY 2011 through FY 2015 funding. A detailed explanation of changes	between the two	budget for
Note: The FY 2010 President's Budget sumittal did not reflect positions is not provided because it cannot be made in a relevance in FY 2010, Congress added \$0.8 million for Process Safeguarding End-User Military Software, \$0.8 million for Comillion for Development of Deployable Biosensors.	ct FY 2011 through FY 2015 funding. A detailed explanation of changes evant manner. Integrated Mechanism for Human-Computer Collaboration and Coordina	between the two ion, \$4.0 million iic Research, an	budget for
Note: The FY 2010 President's Budget sumittal did not reflect positions is not provided because it cannot be made in a reference of the second	ct FY 2011 through FY 2015 funding. A detailed explanation of changes evant manner. Integrated Mechanism for Human-Computer Collaboration and Coordina bal Transformation Laboratory, \$1.6 million for Technologies for Hyperso	between the two ion, \$4.0 million ic Research, an als.	budget for
Note: The FY 2010 President's Budget sumittal did not reflect positions is not provided because it cannot be made in a refer Note: In FY 2010, Congress added \$0.8 million for Process Safeguarding End-User Military Software, \$0.8 million for Co- million for Development of Deployable Biosensors. Note: In FY 2010, efforts moved to Project 2306 from Project Note: In FY 2010, efforts moved to Project 2307 from Project	ct FY 2011 through FY 2015 funding. A detailed explanation of changes evant manner. Integrated Mechanism for Human-Computer Collaboration and Coordina bal Transformation Laboratory, \$1.6 million for Technologies for Hyperson t 2312 in this PE to more accurately align basic research efforts in Mater	between the two ion, \$4.0 million iic Research, an als. Aechanics.	budget for
Note: The FY 2010 President's Budget sumittal did not reflect positions is not provided because it cannot be made in a refer Note: In FY 2010, Congress added \$0.8 million for Process Safeguarding End-User Military Software, \$0.8 million for Co- million for Development of Deployable Biosensors. Note: In FY 2010, efforts moved to Project 2306 from Project Note: In FY 2010, efforts moved to Project 2307 from Project Note: In FY 2010, efforts moved to Project 2311 from Project	ct FY 2011 through FY 2015 funding. A detailed explanation of changes evant manner. Integrated Mechanism for Human-Computer Collaboration and Coordina bal Transformation Laboratory, \$1.6 million for Technologies for Hyperso t 2312 in this PE to more accurately align basic research efforts in Mater t 2313 in this PE to more accurately align basic research efforts in Fluid	between the two ion, \$4.0 million iic Research, an als. Mechanics. ation Sciences.	budget for
Note: The FY 2010 President's Budget sumittal did not reflect positions is not provided because it cannot be made in a refer Note: In FY 2010, Congress added \$0.8 million for Process Safeguarding End-User Military Software, \$0.8 million for Co- million for Development of Deployable Biosensors. Note: In FY 2010, efforts moved to Project 2306 from Project Note: In FY 2010, efforts moved to Project 2307 from Project Note: In FY 2010, efforts moved to Project 2311 from Project Note: In FY 2010, efforts moved from Project 2312 to Project	ct FY 2011 through FY 2015 funding. A detailed explanation of changes evant manner. Integrated Mechanism for Human-Computer Collaboration and Coordina bal Transformation Laboratory, \$1.6 million for Technologies for Hyperson t 2312 in this PE to more accurately align basic research efforts in Mater t 2313 in this PE to more accurately align basic research efforts in Fluid t 2313 in this PE to more accurately align basic research efforts in Fluid t 2313 in this PE to more accurately align basic research efforts in Inform	between the two ion, \$4.0 million ic Research, an als. Mechanics. ation Sciences. opulsion.	budget for

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force		DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	

C. Performance Metrics (U) Under Development.

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Exhibit R-2A, RDT&E Project Just	ibit R-2A, RDT&E Project Justification: PB 2011 Air Force					DATE: February 2010					
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 1: Basic Research		n, Air Force		R-1 ITEM NOMENCLATURE PE 0601102F: Defense Research SciencesPROJECT 612301: Physics							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
612301: Physics	46.896	48.370	50.470	0.000	50.470	47.648	47.498	49.872	52.379	Continuing	Continuing

### 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Investigate regulated, broad-spectrum, variable-energy lasers, laser arrays, and novel bright incoherent light sources.	10.219	10.778	11.530	0.000	11.530
FY 2009 Accomplishments: In FY 2009: Investigated applications of previous research enabling large inexpensive, very bright micro-plasma array ultraviolet sources to large flexible displays, materials curing, and small laser sources. Continued to expand research on high energy, tunable, all solid-state lasers. Studied direct- write micro-systems, including onboard power sources. Applied 3-D laser write techniques in special glasses to inexpensive, flexible subsystems for space.					
FY 2010 Plans: 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.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Se</i>	ciences	<b>PROJECT</b> 612301: <i>Ph</i>	ysics		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Extend studies on infrared semiconductor diode lasers efficiency, and wavelength range at varying temperatures. Study e capable of efficiently converting the wavelength of existing lasers t capable of handling very high average power.	fficient nonlinear optical techniques					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Explore high-energy, electro-energetic device conce molecular properties, atomic collision processes, and atomic.	epts and manipulate atomic and	13.826	13.663	14.743	0.000	14.743
FY 2009 Accomplishments: In FY 2009: Studied the usage of ultra-cold atoms and molecules f system components and ultra-precise measurement techniques us into atomic collision processes and fundamental interactions betwee radiation. Explored the possibility of tailor-making materials using overlap between atomic physics and condensed matter physics. E methodologies for the realization of compact, high-frequency, high sources. Studied quantum effects impacting electron emission fror studies to raise fundamental limits on electrical energy storage der embodying both magnetohydrodynamic and particle-in-cell algorith microwave sources.	sing the results of previous research een atoms, molecules, ions, and the results of research in the xploited emerging microfabrication -power electromagnetic radiation n surfaces. Expanded chaos theory nsity. Created new simulation codes					
FY 2010 Plans: In FY 2010: Continue to investigate compact sources of pulsed rac frequency (e.g., X-rays and beyond) and very high peak-power so particle radiation (e.g., electrons). For precision navigation applica atom interferometry. Explore the possibility of achieving precision I	urces of both electromagnetic and tions, continue to study compact					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research So</i>	ciences	<b>PROJECT</b> 612301: <i>Ph</i>	ysics		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>(i.e., the shot noise limit) by generating and utilizing entangled stat frequency comb techniques for precision sensing and metrology, a based techniques. Explore properties of ultracold molecules for pre Investigate slow and stopped light processes for improving optical the possibility of tailor-making materials, including novel states of r in the overlap between atomic physics and condensed matter physical new condensed matter physical sources. Exploit new knowledge of quantum-level electror generation of low work function field-emission (cold) high current or simulation code algorithms to full 3-D hybrid modeling of high pow</li> <li><i>FY 2011 Base Plans:</i> In FY 2011: Explore quantum states of light and atoms, squeezed precision sensing and metrology beyond the standard quantum lime to explore frequency comb techniques and ultracold atoms and more applications. Explore robust quantum information processing with study quantum-engineering in novel states of matter with cold atom investigate compact sources of high-frequency pulsed radiation ar of both electromagnetic radiation sources. Continue examination of that promise to advance the state-of-the-art in low work-function fieldensity cathodes. Continue innovations in 3-D hybrid modeling of emphasis on parallel computing technology to speed execution time for 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	as well as cold and ultracold atom ecision measurement applications. communication. Continue to explore matter, using the results of research sics. Move from microfabrication to ompact, high-power electromagnetic on emission physics to create new lensity cathodes. Enhance new er microwave sources. or entangled, for advancing hit, i.e., the shot noise limit. Continue blecules for precision measurement ultracold molecules. Continue to ns in optical lattices. Continue to nd very high peak-power sources in micro- and nano-fabrication that ra-high-frequency, compact high- materials science innovations eld-emission (cold) high current high power microwave sources with					
		5.481	5.948	6.513	0.000	6.513

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sc</i>	ciences	PROJECT 612301: Physics			
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Advance technologies for space sensors, imaging, and effective space situational awareness.	identification and tracking methods,					
FY 2009 Accomplishments: In FY 2009: Investigated fundamental limits affecting ground-base of space objects. Developed improved adaptive optics and post-p image resolution. Studied spectral, polarimetric, and temporal app object identification. Continued the study of fundamental process affects atmospheric density to lead to physics-based methods of tracking.	processing techniques for improved proaches to unresolved space es in the solar-terrestrial system that					
FY 2010 Plans: In FY 2010: Investigate new sensing modalities to improve resolut based and space-based surveillance of space objects. Continue s temporal signatures of space objects to identify unresolved space in active imaging techniques. Investigate inclusion of fundamenta system into physics-based models to predict atmospheric density orbit prediction and precision tracking.	study of spectral, polarimetric, and objects. Investigate physics involved al processes of the solar-terrestrial					
FY 2011 Base Plans: In FY 2011: Continue to develop new sensing modalities that reduprecision tracking of space objects. Investigate new methods of unobjects and incorporate this investigation in the identification of unstudy of the physics of signatures in the scattering and reflection research into fundamental processes and energy sources affecting understanding of precursors to atmospheric density variations.	niquely identifying unresolved space ncorrelated space objects. Continue of light during active imaging. Expand					
FY 2011 OCO Plans: In FY 2011 OCO: N/A						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research So</i>	ciences	<b>PROJECT</b> 612301: <i>Ph</i>	nysics	/sics	
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>MAJOR THRUST: Research space environment to improve solar of solar phenomena, space weather, magneto/ionosphere effects,</li> <li><i>FY 2009 Accomplishments:</i> <ul> <li>In FY 2009: Emphasized development of cost effective micro Investigated requirements of boundary conditions and initial vexploited newly developed radio astronomy techniques for rein the continued search for understanding of fundamental phy heliospheric, magnetospheric ionospheric, and thermospheric our ability to forecast near-Earth space environment using first investigation of the fundamental plasma modeling theory usin full kinetic modeling techniques. Continued ground-based and development for remote sensing and in situ measurement of a developing understanding of fundamental processes of energy environment to support protection of space assets and to explosystem through advanced modeling techniques. Analyzed da improve remote sensing of interplanetary space. Maintained the neutral densities and winds above 150 kilometers for satellite</li> </ul> </li> <li><i>FY 2010 Plans:</i> <ul> <li>In FY 2010: Continue developing of methods to sense atmost using small, inexpensive satellites. Continue the study of spatechniques. Investigate fundamental processes to enable the environment. Investigate coupling and dependencies of the vertice through the Earth's atmosphere that would enable the unders various regions. Investigate plasma instabilities in the equato communication and navigation signals. Expand the study of provide the study of provide the study of provide the study of plasma instabilities in the equation communication and navigation signals. Expand the study of provide the study of provide the study of plasma instabilities in the equation communication and navigation signals.</li> </ul></li></ul>	space debris, adaptive optics. satellites for space weather sensing. alues for driving space weather models. mote sensing the space environment sics and processes controlling solar, environments with a focus on improving the principles physics models. Expanded g new electromagnetic, grid-free, d space-based sensor technology space weather conditions. Continued etic particle scattering in the near-Earth lore the solar interior as a complex ta from DoD surveillance satellites to occused research to investigate the drag.	5.720		6.774	0.000	6.774

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			1	DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research S</i>	ciences	<b>PROJECT</b> 612301: <i>Ph</i>	nysics		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans: In FY 2011: Investigate proxy indicators of ionospheric and atr be sensed using inexpensive but effective techniques. Investig calculations of plasma processes in the magnetosphere and ic atmosphere and solar wind. Continue the study of energy flow environments. Continue to study plasma instabilities and plasm ionospheres.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	ate methods to exploit grid-free mosphere as well as in the solar between solar and terrestrial					
MAJOR THRUST: Research physical mathematics and applied and physical phenomena to enhance the fidelity of simulation. Conduct <i>FY 2009 Accomplishments:</i> In FY 2009: Investigated properties of coherently propagating atmosphere for their exploitation as high power microwave sour nonlinear optical effects within fiber lasers and nonlinear optical lasers can be realized. Initiated a modeling/simulation effort to dynamics of transonic/supersonic/hypersonic platforms to verifi near optimal. Modeled the effects of the dynamics of the upper altitude platforms as well as to assure the effective uses of the results to the airborne laser program and to the Air Force's Air altitude platforms. Verified the design of reconfigurable warhear micro-detonators as well as the effects of various metal inclusi methods for recognizing and tracking targets and for penetratin that obscure targets. Pursued the design of electromagnetic so	research in electromagnetics. ultra-short laser pulses through the urces. Upgraded algorithms to simulate al media so that simulation of various codify the theoretical work on the ty that designs and operations are r atmosphere on the stability of high ir optical inventory; communicated these Combat Command, for the latter's high ads through suitable timing/placement of ons on lethality. Continued to improve ng coverings or other dispersive media	9.655	10.186	10.910	0.000	10.91

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research So</i>	ciences	<b>PROJECT</b> 612301: <i>Ph</i>	ysics		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>materials, can transmit optimized waveforms for a variety of surcede which allows the user to simulate these sources.</li> <li><i>FY 2010 Plans:</i> <ul> <li>In FY 2010: Increase research into the susceptibility to upset of exposed to suitable electromagnetic waveforms. Continue to pup propagation of ultra-short laser pulses through the atmosphere attributes as well as exploiting such potentials as sources of ter distance spectroscope, and components of laser-guided bombs: Increase support for research into the possibility of identifying e are optimal from the perspective of instances of various dispersairplane boundary layers), where optimality is defined as securrobjects obscured by such media.</li> </ul> </li> <li><i>FY 2011 Base Plans:</i> <ul> <li>In FY 2011: Increase basic research support for designing smarcan provide both secure communication and sophisticated wave through various dispersive media. Such sources will depend creater of the combined to form partially coherent beams which are atmospheric turbulence than are standard fully coherent laser b research with emphasis on digital circuits.</li> </ul> </li> </ul>	f various electronic circuits when ursue a deeper understanding of the with emphases on managing their rahertz radiation, components of a long- s or ladar when cloud cover is present. electromagnetic waveforms which sive media (foliage, clouds, buildings, ing improved spatial resolution of all, highly directive sources which reforms which optimally propagate ucially on progress in the area of splay attributes not currently available. e optically pumped and, in addition, predicted to be less disturbed by					
In FY 2011 OCO: N/A						
		44.901	46.777	50.470	0.000	50.470

Exhibit R-2A, RDT&E Project Justi	ification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIV</b> 3600: <i>Research, Development, Test</i> BA 1: <i>Basic Research</i>		, Air Force		<b>R-1 ITEM N</b> PE 0601102			ciences	<b>PROJECT</b> 612301: <i>Ph</i>	ysics		
B. Accomplishments/Planned Pro	gram (\$ in M	illions)						1			
							FY 2009	FY 2010	]		
Congressional Add: Center for Micro	oplasma Scie	nce and Teo	chnology (CN	MST).			1.995	0.000			
FY 2009 Accomplishments: In FY 2009: Created a National	Center for th	e microplasi	ma research	field.							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
Congressional Add: Development of	f Deployable	Biosensors					0.000	1.593			
FY 2009 Accomplishments: In FY 2009: Not Applicable.											
FY 2010 Plans: In FY 2010: Fundamental resea equipment and nanoscale analy						on					
				Congre	essional Add	s Subtotals	1.995	1.593	]		
C. Other Program Funding Summa	ary (\$ in Mill	ions)									
		-	<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	Base	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>			Total Cost
• PE 0602203F: Aerospace Propulsion.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602204F: Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602500F: <i>Multi-Disciplinary Space Technology.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justi	xhibit R-2A, RDT&E Project Justification: PB 2011 Air Force										
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research			<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: Defense Research Sciences <b>PROJECT</b> 612301: F					-			
C. Other Program Funding Summa	ary (\$ in Mill	ions)									
Line Item	FY 2009	FY 2010	<u>FY 2011</u> Base	<u>FY 2011</u> OCO	<u>FY 2011</u> Total	FY 2012	FY 2013	FY 2014	FY 2015	<u>Cost To</u> Complete	Total Cost
• PE 0602601F: Space Technology.	<u> 2000</u>	<u> </u>		<u></u>		<u> <b></b> .</u>	<u> </u>	<u></u>	<u> 2010</u>		10101 0001
• PE 0602605F: Directed Energy Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

### **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, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research				IOMENCLA 2F: Defense		ciences	<b>PROJECT</b> 612302: Solid Mechanics and Structures				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
612302: Solid Mechanics and Structures	16.921	19.666	20.683	0.000	20.683	19.663	18.848	19.955	20.903	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. The goals are cost-effective development and safe, reliable operation of superior Air Force weapon and defensive systems. Fundamental knowledge of "multi-functional" structures with smart materials, sensors, actuators, and control systems integrated to accomplish damage control, thermal management, vibration reduction, and reconfigurable shapes. Research topics include: the modeling of non-linear static/dynamic behavior of structures; mechanical reliability of micro-devices; design of multi-functional materials; mechanical behavior of nanomaterials; and composite materials for structures.

#### **B. Accomplishments/Planned Program (\$ in Millions)**

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Explore the integration of advanced nano materials and devices into turbine engines, air vehicles, space systems, and other weapon systems, and develop new mechanics.	8.050	9.422	9.930	0.000	9.930
FY 2009 Accomplishments: In FY 2009: Continued research in the area of multifunctional hybrid composite systems for sensing and neutralization of exogenous threats to load-bearing capability. Conducted 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 developed the fundamental knowledge required to design and manufacture multi-functional aerospace material systems and devices and to predict their performance and structural integrity. Continued developing and exploiting methods that combine information technology and multi-scale modeling in the design of new material systems.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Feb	ruary 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research So</i>	ciences	<b>PROJECT</b> 612302: So	<b>PROJECT</b> 612302: Solid Mechanics and Structures				
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
FY 2010 Plans: In FY 2010: Expand research in the area of multifunctional mat reconfigurable structures allowing shape change and property of multifunctional hybrid composite systems for sensing and ne load-bearing capability. Continue research in the areas of diage self-healing, thermal management, energy harvesting/storage, transmission, and micro-/nano-mechanics to enable safer and with improved performance characteristics. Further develop the design and manufacture multi-functional aerospace material sy performance and structural integrity.	tuning. Continue research in the area autralization of exogenous threats to nostics, prognostics, autonomics, electromagnetic energy radiation/ more durable aerospace structures a fundamental knowledge required to							
FY 2011 Base Plans: In FY 2011: Expand research in the area of multifunctional mat sensing and self-diagnosis of exogenous threats. Continue res materials and microsystems for reconfigurable structures allow Continue research in the areas of prognostics, autonomics, sel harvesting/storage, electromagnetic energy radiation/transmiss enable safer and more durable aerospace structures with impre Further develop the fundamental knowledge required to design aerospace material systems and devices and to predict their pe	earch in the area of multifunctional ing shape change and property tuning. f-healing, thermal management, energy sion, and micro-/nano-mechanics to oved performance characteristics. and manufacture multi-functional							
FY 2011 OCO Plans: In FY 2011 OCO: N/A								
MAJOR THRUST: Analyze structural fatigue and mechanics, adap improve the design, robustness, and performance of air and space		8.871	10.244	10.753	0.000	10.753		

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research</i> S	ciences	<b>PROJECT</b> 612302: Sc	lid Mechanie	cs and Struc	tures
3. Accomplishments/Planned Program (\$ in Millions)	1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Expanded the novel theoretical and experimental to achieve broader operational capabilities. Utilized novel actu Force aircraft and space structural applications. Expanded the acceptance into new structures of the novel materials develop programs, and used the knowledge to develop new aerospace development of structural health monitoring sensors and techn wide approach. Consolidated an integrated approach to structure reliability. Expanded the understanding of mechanical and dyn structures to generate novel structural concepts. Investigated n with the structural deformation and aero-elastic instabilities and structural concepts.	ation devices and materials for Air study of the science related to the ed under the advanced materials structural concepts. Continued the iques towards an integrated vehicle- ural systems lifetime prognosis and amic behavior of micro-/nano-scale nonlinear phenomena associated					
FY 2010 Plans: In FY 2010: Search for unprecedented new and revolutionary to broader operational capabilities, a faster reconfigurable ability, fabrication; this search will include morphing aircraft structures and materials for Air Force aircraft and space structural applica related to new structures of the novel materials developed und Expand development of structural health monitoring sensors a vehicle health monitoring and operational capability prognosis. structural systems lifetime prognosis and reliability. Expand un behavior of flight structures under extreme environments (e.g., dynamics, unsteady aero-thermo-elastic effects on flight struct of enhancing operational survivability and mission success.	and more affordable accelerated . Investigate novel actuation devices ations. Expand scientific knowledge er the advanced materials programs. Ind techniques towards an integrated Understand a risk-based approach to derstanding of mechanical and dynamic intense vibration, nonlinear structural					

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce					DATE: February 2010					
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 1: Basic Research		, Air Force		<b>R-1 ITEM N</b> ( PE 0601102	-	-	ciences	PROJECT 612302: Solid Mechanics and Structu			tures		
B. Accomplishments/Planned Prog	gram (\$ in M	illions)	I					1					
		·					FY 2009	FY 2010	FY 2011 Base	-	-	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Continue to seek ne operational capabilities, a faster Investigate new structures of no identify a proof-of-concept demo sensors and techniques and tes understanding of dynamic and r (intense vibration, nonlinear strueffects etc.) to increase operatio</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: N/A</li> </ul>	reconfigural ovel materials onstration. Ex ot the develop mechanical b uctural dynan	ble ability, ar developed kpand the ur bed new scie ehavior of fli nics, unstead	nd more affo under the ac nderstanding ence under la ight structure dy aero-them	rdable accele lvanced mat of structura aboratory co es under extr mo-elastic ef	erated fabric erials progra health mon nditions. Enl eme enviror	cation. ams and itoring nance the nments							
			Accomplish	ments/Plann	ed Program	s Subtotals	16.921	19.666	20.683	0.000	20.68		
C. Other Program Funding Summa	ary (\$ in Mill	ions)											
			<u>FY 2011</u>	FY 2011	FY 2011					Cost To			
Line Item	FY 2009	<u>FY 2010</u>	Base	000	<u>Total</u>	FY 2012	FY 2013	FY 2014		Complete			
• PE 0602102F: Materials.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00		
• PE 0602201F: Aerospace Flight Dynamics.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00		
• PE 0602202F: Human Effectiveness Applied Research.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00		
• PE 0602203F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00		
Propulsion.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00		
	0.000	0.000	0.000	UNCLAS	0.000	0.000	0.000	0.000	0.000	0.000			

Exhibit R-2A, RDT&E Project J	ustification: PB	2011 Air Fo	rce						DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research				<b>R-1 ITEM N</b> PE 0601102			ciences	<b>PROJECT</b> 612302: Solid Mechanics and Structures				
C. Other Program Funding Sun	nmary (\$ in Mill	ions)										
Line Item • PE 0603211F: Aerospace Structures.	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u> <u>Base</u>	<u>FY 2011</u> <u>OCO</u>	<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>	
<b>D. Acquisition Strategy</b> Not Applicable.												
E. Performance Metrics Please refer to the Performance	e Base Budget C	Verview Boo	ok for inform	nation on how	Air Force re	esources are	applied ar	nd how those	resources a	are contributir	ng to Air	

Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research			<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>				PROJECT 612303: Chemistry				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
612303: Chemistry	36.584	38.957	41.587	0.000	41.587	40.207	38.953	40.459	42.500	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Research and characterize molecular dynamics, reaction mechanics/interactions, and theoretical chemistry to model, predict, control, and exploit atomic and molecular energetics.	15.888	16.382	17.485	0.000	17.485
FY 2009 Accomplishments: In FY 2009: Continued to develop new capabilities to predict molecular and macroscopic properties of chemicals of interest to the Air Force. Explored properties and potential of nano-scale energetic materials. 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. Continued developing novel applications of catalysis and plasmonic structures for applications to propulsion, energetics, and sensing. Explored new concepts for closed- cycle hybrid chemical lasers.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research S</i>	ciences	<b>PROJECT</b> 612303: <i>Ch</i>	nemistry		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Advance the development of experimental and the control chemical reactivity and energy in molecular systems. If mechanisms in systems that can improve energy utilization in p synthetic methods and computational screening procedures to propellants. Investigate methods for producing energetic metas lifetimes. Explore the mechanisms of processes induced by plachemical processes. Perform experiments and theoretical anal of chemistry in the space environment. Investigate novel approchemical lasers.</li> </ul>	Develop the understanding of catalytic propulsion applications. Explore streamline the production of novel stable species and analyzing their ismonic structures and its impact on ysis to provide benchmarks for models					
FY 2011 Base Plans: In FY 2011: Create a fundamental understanding of basic cher nanoscale. Develop methods that can describe material behav mesoscopic and macroscopic scales and simulate chemical pr Develop theoretical methods to predict energy and density of n methods to use catalysis to improve energy utilization and stor sensors for detecting trace species. Perform experiments and processes in space for situational awareness. Investigate proce- hybrid laser concepts.	ior from the atomic level through ocesses to model bulk scale properties. ovel energetic materials. Explore age. Create new selective and sensitive simulations to understand chemical					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.						
MAJOR THRUST: Enhance fundamental understanding of polymer molecular engineering, processing controls, and materials technolo		11.707	12.698	13.510	0.000	13.510

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force							
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research</i> S	Sciences	<b>PROJECT</b> 612303: <i>Cl</i>	nemistry			
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2009 Accomplishments: In FY 2009: Exploited nanotechnology to enhance functional a through controlled dispersion, distribution, and placement of th applications. Studied the controlled synthesis of new polymers storage functions. Conducted the modeling, synthesis, and ch to understand and enhance the charge mobility of organic bas polymers.</li> <li>FY 2010 Plans: In FY 2010: Further exploit advances in nanotechnology to immaterials for antenna substrate applications. Explore hybrid m limiting behavior and optical filtering response for broadband I charge mobility of organic transistors to enable higher speed r</li> <li>FY 2011 Base Plans: In FY 2011: Explore organic transistors with flexibility, mechar or equivalent of a-Si transistors. Explore rewritable color 3-D h polymers. Assess feasibility of controlling chirality of molecular</li> </ul>	e nano-entities for Air Force with improved power generation and aracterization of conjugated polymers ed semi-conducting organics and prove properties of magneto-dielectric aterials approach to enhance optical aser protection applications. Improve esponses for Air Force applications.						
behavior in the optical or Infrared range. <i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.							
MAJOR THRUST: Characterize, model, and exploit the fundament surface and interfacial degradation from completely frictionless to t <i>FY 2009 Accomplishments:</i> In FY 2009: Continued to develop theoretical and predictive m understanding of the structure and reactivity of surfaces and h	otal deterioration." ethods for the fundamental	8.989	9.877	10.592	0.000	10.592	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sc</i>	ciences	<b>PROJECT</b> 612303: <i>Ch</i>	emistry		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
environment at the interface. Investigated phenomena at surfa wear, lubrication, corrosion, and degradation. Explored novel a particularly multi-disciplinary efforts that combine corrosion init Continued tribological investigations in nano- composite lubrica variety of extreme environments, including space.	approaches to corrosion prevention, tiation, detection, and lifetime prediction.					
FY 2010 Plans: In FY 2010: Continue to develop theoretical and predictive me of the structure and reactivity of surfaces and interfaces, partic Continue to investigate phenomena at surfaces and interfaces of friction and wear, lubrication, corrosion, material degradation transport. Develop methods for understanding and controlling complex materials, including nano-composite lubricants that pr extreme environments. Develop instrumentation and methodol chemistry and kinetics with high spatial resolution.	cularly under non-equilibrium conditions. , including the fundamental mechanisms n in extreme environments, and thermal interfacial chemistry in the creation of rovide function over a wide variety of					
FY 2011 Base Plans: In FY 2011: Apply knowledge of chemical and morphological e surfaces towards development of theoretical and predictive mo hybrid surfaces and materials across multiple length scales. In physics of surface wear driving towards a comprehensive unde environment. Develop real-time nano-tribological instrumentation.	odels for degradation of complex and westigate fundamental chemistry and erstanding of the role of the chemical					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.						

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
	<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research				DMENCLAT F: Defense	<b>URE</b> Research Sc	iences	<b>PROJECT</b> 612303: <i>Ch</i>	emistry		
C. Other Program Funding Summa	ary (\$ in Milli	ions)									
			<u>FY 2011</u>	FY 2011	FY 2011					Cost To	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<b>Complete</b>	Total Cost
• PE 0602102F: <i>Materials.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602203F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Propulsion.											
• PE 0602500F: <i>Multi-Disciplinary</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Space Technology.											
• PE 0602601F: Space	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology.											
• PE 0602602F: Conventional	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Munitions.											

#### **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, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research				R-1 ITEM NOMENCLATURE PE 0601102F: Defense Research SciencesPROJECT 612304: Mate				athematics and Computing Sciences			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
612304: <i>Mathematics and</i> <i>Computing Sciences</i>	28.707	33.208	37.697	0.000	37.697	36.221	37.258	39.215	41.193	Continuing	Continuing

### 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Perform dynamics and control research to develop innovative techniques for design and analysis of complex control systems.	14.667	16.917	19.161	0.000	19.161
<i>FY 2009 Accomplishments:</i> In FY 2009: Further developed the design and analysis techniques 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. Continued developing control methodologies to improve non-equilibrium behavior of complex, unsteady fluid systems. Advanced image processing and sensor technologies for use in UAV controllers, smart munitions, and non-destructive testing of vehicles. Developed 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. Further developed theory and algorithms for specification, design, verification, and validation of distributed embedded systems. Studied novel devices to exploit nonlinear					

				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sci</i>	ciences	<b>PROJECT</b> 612304: <i>Ma</i>	<b>COJECT</b> 2304: <i>Mathematics and Computing</i> S				
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>dynamic phenomena with a focus on detection, classification, a combat environments.</li> <li>FY 2010 Plans:</li> <li>In FY 2010: Develop the design and analysis techniques for councertain, adversarial environments with applications to swarm constellations of small satellites with an emphasis on heteroge robot interactions. Expand additional research for teams of mice</li> </ul>	poperative control systems in dynamic, ns of smart munitions, UAVs, and neous agents and mixed human-							
altitudes in complex environments to execute assigned mission to include adaptive control and machine learning. Develop con equilibrium behavior of complex, nonlinear systems. Continue sensor technologies for use in UAV controllers and smart mun ownship state estimation. Develop mathematical control theore nonlinear, hybrid dynamics of microbiological systems. Develop	ns with variable operator intervention trol methodologies to improve non- to advance image processing and itions to include target tracking and etic models that capture the robust,							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research S</i>	ciences	<b>PROJECT</b> 612304: <i>Ma</i>	athematics a	nd Computin	ng Sciences
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>technologies for use in cooperative teams of UAVs and smart tracking, ownship and world state estimation. Continue develop models that capture the robust, nonlinear, hybrid dynamics of develop methods for design and analysis of bio-inspired sensing syste systems. Continue development of algorithms for control of ar Continue development of theory and algorithms for specificati distributed embedded control systems.</li> <li><i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A</li> <li>MAJOR THRUST: Conduct research in optimization, as well as co validate and further advance mathematical methods, algorithms, a <i>FY 2009 Accomplishments:</i> In FY 2009: Developed rigorous mathematical methods for so logistics, system diagnostics/prognostics, air mobility continge tactical planning for battle space information management. Er in operation research, meta heuristic searches, and robust, st developing innovative and accurate mathematical and numeri simulation capabilities, including aerodynamics as applicable hypersonics and Micro Air Vehicles. Continued to develop and optimization strategies with high-order, time-accurate solution directed energy devices, munitions and penetrators, air and si and maintenance systems. Enhanced uncertainty analysis in and structural failure predictions. Developed mathematical methods for so would deal with operational data that are possibly incomplete,</li> </ul>	<ul> <li>appment of mathematical control theoretic microbiological systems. Further</li> <li>ams, controls, and computational and over dynamic, large-scale networks.</li> <li>bon, design, verification, and validation of</li> <li>amputational and discrete mathematics, to nd modeling and simulation.</li> <li>amputational and complex problems in ncies, target tracking, and strategic/</li> <li>ananced the analytical tool developments ochastic optimization. Focused on cal algorithms to improve modeling and to a range of flight regimes such as a integrate new multi-disciplinary design is for superior design of jet engines, bace components, and system health non-linear models of aerodynamic flows odels that are dynamically evolving that</li> </ul>	14.040	16.291	18.536	0.000	18.536

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research So</i>	ciences	<b>PROJECT</b> 612304: <i>Ma</i>	athematics a	nd Computir	ng Sciences
B. Accomplishments/Planned Program (\$ in Millions)	1		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans: In FY 2010: Continue to develop theoretically rigorous and compute methods for solving large and complex problems in logistics, syster air mobility contingencies, engineering design, target tracking, and for battle space information management. Meta heuristic searches methods and emphasis is placed on those for which provable boun on development of innovative mathematical and numerical algorithr and simulation capabilities in understanding and forecasting of com and design and control of systems of interest to the Air Force. The include non-equilibrium plasma, non-steady aerodynamics for vario design, and structural mechanics. Focus on numerical algorithms th physics approaches with particular emphasis on convergence, erro Increase emphasis on development of algorithms for efficient and re optimization as well as understanding and quantifying the effects of models.</li> </ul>	n diagnostics/prognostics, strategic/tactical planning are combined with rigorous ds are shown. Place emphasis ns that enhance modeling uplex physical phenomena application areas of interest us flight regimes, material nat include multi-scale and multi- r analysis and adaptability. obust multidisciplinary design and					
In FY 2011: Continue to support new theoretically rigorous and commethods for solving large, complex problems in logistics, system dia mobility contingencies, engineering design, target tracking, and stracooperative control) for battle space information management. Meta heuristic serigorous search techniques, with emphasis on the mathematical un rigorous error bounds when convergence to non-optimal solutions of mathematically rigorous numerical algorithms for enhancing the moc complex, multi-scale, and nonlinear systems and phenomena of int application areas in plasma, aerodynamics, structural mechanics, a increasing challenges in capturing the unsteady, dynamic, multi-physical sectors.	agnostics/prognostics, air ategic/tactical planning (including earches are being combined with derpinning and the establishment of occurs. Continue developing odeling and simulations of large, erest to the Air Force. The and materials will emphasize the					

Exhibit R-2A, RDT&E Project Just	ification: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 1: Basic Research		a, Air Force		<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>				<b>PROJECT</b> 612304: <i>Mathematics and Computing</i>			g Science
B. Accomplishments/Planned Pro	gram (\$ in N	lillions)	I					1			
		<i>r</i>					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
problems. Continue to focus on computational science, informa and analysis of complex system strategies with high-order, time- <i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A	tion theory, s ns. Support d	tatistics, and evelopment	d probability and integrat	to lead to be tion of novel	tter understa optimization	anding					
			Accomplish	ments/Plann	ed Program	s Subtotals	28.707	33.208	37.697	0.000	37.69
C. Other Program Funding Summa	ary (\$ in Mill	<u>ions)</u>	FY 2011	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	FY 2010	Base	000	Total	FY 2012	FY 2013	FY 2014	FY 2015		Total Cos
• PE 0602201F: Aerospace Flight Dynamics.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602203F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Propulsion.											
• PE 0602500F: <i>Multi-Disciplinary</i> <i>Space Technology.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602602F: Conventional Munitions.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602702F: Command, Control, and Communications.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603789F: C3I Advanced Development.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
<b>D. Acquisition Strategy</b> Not Applicable.											
				UNCLAS	SIFIED						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		_	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>	<b>PROJECT</b> 612304: <i>M</i> a	athematics and Computing Sciences

### **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, RDT&E Project Jus	tification: PE	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTI 3600: Research, Development, Tes BA 1: Basic Research		n, Air Force			1 ITEM NOMENCLATURE       PROJECT         2 0601102F: Defense Research Sciences       612305: Electronics						
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
612305: Electronics	36.876	40.401	45.066	0.000	45.066	43.056	42.368	44.526	46.763	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Investigate novel detector and electronic materials, device concepts, and circuit architecture and implementation schemes important to future military space platforms.	8.790	9.821	10.987	0.000	10.987
FY 2009 Accomplishments: In FY 2009: Investigated 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. Investigated 'smart' reconfigurable materials whose properties can be dynamically tailored via self-programming or system software in response to changing behavior or mission needs. Focused on novel 'programmable pathways' to enable tailoring novel hybrid material systems such as metamorphic and heterogeneous systems.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Scie</i>	ences	<b>PROJECT</b> 612305: <i>El</i>	ectronics		
B. Accomplishments/Planned Program (\$ in Millions)	· · · ·		1			
	F	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Investigate novel methods for achieving integrated detection utilizing spatial, spectral, polarimetric, radiometric, pl imaging detection and discrimination techniques, to include ad or detector element approaches spanning multiple-modes, and bands; biologically inspired detection processes and concepts detector structures will include, but not limited to, integrated m utilizing homogeneous and/or heterogeneous semiconductor a enabled by 0D, 1D, and/or 2D quantum-based structures. Add electronic defect engineering physics will be studied to determ band structure that critically affects photon absorption and carr FY 2011 Base Plans:</li> <li>In FY 2011: Continue investigating novel multi-modal electrom and concepts utilizing increased understanding of phenomeno background radiation and novel nano-materials, -structures, at placed on achieving material structures yielding linearly-graded semicon of dynamic bandgap tuning over the range ~ 0.2 - 2.5eV. In ac structures capable of dynamic absorption coefficient tuning wil for thin-film spectra-filter tuning. Continued emphasis shall be semiconductor hetero-interface band misalignments that critical controlling these alignments is an elusive holy grail for semico game changing electronic and photonic device capabilities.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	hase, and temporal imaging and non- laptive reconfigurable 'pixel' and/ d in one or more ultraviolet-infrared will also be considered. Possible novel onolithic and/or hybrid approaches and oxide material structures, potentially litionally, bulk and nano-structure based ine opportunities for modifying electronic rier transport properties. hagnetic spectra detection approaches logical interactions between target/ nd -devices. Specific emphasis will be ductor bandgap behavior or capable Idition, novel materials and/or device II be studied, along with concepts placed on physics controlling ally control carrier transport properties;					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research</i> St	PROJECT 612305: <i>Electronics</i>				
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Investigate quantum and optoelectronic materia processing, and nano-science for wide-field spectral sensors and o <i>FY 2009 Accomplishments:</i>	15.141	15.801	16.967	0.000	16.967	
In FY 2009: Investigated nonlinear optical and laser materials, for radiation protection, cloaking and tracking, and target signal nanoelectronics, nanophotonics, spintronics, multi-functional no optoelectronic, magnetic, and electronic materials and devices efficiency wavelength-diverse lasers, and high-sensitivity deter of advanced optical memory technologies for enhanced data se refraction metastructures and photonic crystals. Investigated to miniature terahertz frequency spectrum devices, quantum cass investigation of communication network technologies, room ter the interaction of system electronics and sensors with atmospl	ture identification. Explored naterials, and other advanced for lower power consumption, high- ctors. Furthered the examination torage, including negative index of echnologies for robust monolithic and cade lasers, and plasmonics. Continued mperature ferromagnetic materials, and					
<i>FY 2010 Plans:</i> In FY 2010: Further support research activities to better under						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force	DATE: February 2010					
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research S</i>	ciences	<b>PROJECT</b> 612305: <i>Ele</i>			
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Continue advanced research efforts to better deter multi-ferroic materials for a wide variety of technologically adva Continue to explore the suitability of spintronic device elements performance ultra-miniature logic and control systems. Further electronic materials that enable all photonic signal processing a explore integration of these advanced technologies with RF Mic concepts. Further explore wide band gap semiconductors for h applications with an in-depth understanding of device reliability materials and nanostructures that will permit an expansion of d limits on silicon technology.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	anced applications for the warfighter. a that can be integrated into high explore special semiconducting and and logic technology, and begin to cro Electro-Mechanical Systems igh performance, high power RF issues. Continue research on special					
MAJOR THRUST: Exploit advances in nanotechnology to support n scale optical networks, and compact power.	nulti-spectral detection technology, chip-	6.264	7.161	8.328	0.000	8.328
FY 2009 Accomplishments: In FY 2009: Exploited controlled growth of self-assembled quar these structures for multi-spectral image processing. Tested fur improved growth methods. Continued developing and improvin nanophotonics for guided wave and free space optoelectronic of their integration to enable chip-scale optical networks that will of Explored nanophotonic concepts for information processing con	nctionalities of structural materials and og knowledge of nanoelectronics and device technology and methods for overcome future interconnect problems.					
FY 2010 Plans: In FY 2010: Develop revolutionary infrared sensors with new fu the complexity, cost, and size of conventional imaging systems						

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APPROPRIATION/BUDGET ACTIVITY         R-1 ITEM NOMENCLATURE           600: Research, Development, Test & Evaluation, Air Force         PE 0601102F: Defense Research S		PROJECT					
BA 1: Basic Research				PROJECT 612305: Electronics			
B. Accomplishments/Planned Program (\$ in Millions)							
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>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 plasmonbased, Complimentary Metal-Oxide Semiconductor - 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.</li> <li><i>FY 2011 Base Plans:</i></li> <li>In FY 2011: Pursue research in light localization below the wavelength scale, using concepts of plasmon optics, photonic crystal, and metamaterial nanophotonics for ultra-compact integrated photonic systems, ultra-compact optically functional devices, light-harvesting elements for molecular and</li> <li>nanocrystalline-based photovoltaic devices, lithographic patterning at deep sub-wavelength dimensions, and aberration-free lenses that enable optical imaging with unprecedented resolution. Continue to exploit silicon-compatible components for photonics and take advantage of the mature processing and</li> <li>manufacturing expertise that silicon technology affords. Pursue smaller and more highly integrated optical subsystems for telecommunications applications and high speed processing. Explore thermoelectric applications of silicon and germanium based nanomembranes made into nanowires and nanoribbons plus nanowire for applications in photoelectrochemical cell technology, and thermoelectric device technology.</li> </ul>							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Feb	uary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research				PROJECT 612305: Electronics			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
MAJOR THRUST: Investigate quantum electronic solids phenomena negative index, and nanoscopic materials.	to explore superconducting, magnetic,	6.681	7.618	8.784	0.000	8.784	
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Constructed and tested a low-noise, wide-bandwidth thin-film Josephson-junction technology. Attempts to fabricate him magnetic materials were given greater emphasis in providing surand other advanced systems. Studies to reduce eddy-current loss in superconducting tapes were augmented as the tape technolog goals. Progressed in seeking practical negative index materials Nanoelectronic circuitry based on nanomaterials and new concernatempting to promote miniaturization, greater functionality, and new higher-temperature (and practical) superconductors.</li> <li>FY 2010 Plans:</li> <li>In FY 2010: The program discovers more useful, economical surapplications progress has been made toward identifying promisi physics, chemistry and materials science. Further exploration in both magnesium diboride and yttrium-barium-copper-oxide super determine whether these unique structures have a potential to b systems. Research continues to find routes to make nanoscale of use of metamaterials form to produce sub-wavelength ima memory elements using crossbar architecture in contact with states of metamaterials that are manipulated and entangled so that science are tested at room temperature. Continue investigation in the states that are manipulated and entangled so that science are tested at room temperature.</li> </ul>	gh-temperature, high-performance pport for the More-Electric-Airplane sses and to prevent quenching gy continued to reach desired over a broad range of frequencies. tots also received added emphasis in lower losses. Continued searches for perconductors for power and electronic ng materials, new advances in superconducting electronics using erconducting films is planned to ecome the basis for improved radar ordered structures that will open the tomagnetic spectrum. At microwave ging. Continue studying denser andard CMOS circuitry.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: Feb	ruary 2010	
PROPRIATION/BUDGET ACTIVITY       R-1 ITEM NOMENCL         00: Research, Development, Test & Evaluation, Air Force       PE 0601102F: Defens         1: Basic Research       PE 0601102F: Defens					-	-	ciences	<b>PROJECT</b> 612305: <i>Ele</i>	ectronics		
B. Accomplishments/Planned Pro	ogram (\$ in M	lillions)									
		·					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
carbon nanotubes that form th Metamaterials research contin Investigation of superconducto begins on making larger quant effectiveness. FY 2011 OCO Plans: In FY 2011 OCO: N/A	nues to produc	e more effici everal new si	ient and sma uperconduct	aller, omni-dii ting materials	rectional ant s, and resea	ch					
			Accomplish	iments/Plann	ed Program	s Subtotals	36.876	40.401	45.066	0.000	45.066
C. Other Program Funding Sumn	nary (\$ in Mill	ions)	FY 2011	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	<u>FY 2010</u>	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	Complete	Total Cos
• PE 0602204F: Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602702F: Command, Control, and Communications.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0603203F: Advanced Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0603789F: C3I Advanced Development.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
<b>D. Acquisition Strategy</b> Not Applicable.											
<b>E. Performance Metrics</b> Please refer to the Performance E Force performance goals and mo					Air Force re	esources are	applied an	d how those	resources a	re contributi	ng to Air

Exhibit R-2A, RDT&E Project Just	tification: PE	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 1: Basic Research		n, Air Force		-			PROJECT 612306: <i>Materials</i>				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
612306: Materials	24.104	29.321	32.040	0.000	32.040	31.134	30.964	32.611	34.225	Continuing	Continuing

#### <u>Note</u>

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 manmade 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Perform non-metallic, ceramic, and hybrid materials research to identify/design new materials and composites with very-high (>1400F) and ultra-high (>2500F) temperature.	11.599	11.966	12.872	0.000	12.872
FY 2009 Accomplishments: In FY 2009: Continued optimizing the design of multi-functional structural ceramics materials to enable structurally enhanced smart systems for application in extreme environments. Expanded the development of new approaches in improving the thermal and mechanical stability of ceramic and metallic composites for aerospace applications. Explored the role of the operational environment on					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research</i> S				<b>ECT</b> 6: <i>Materials</i>				
B. Accomplishments/Planned Program (\$ in Millions)			1						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total			
<ul> <li>the mechanisms of failure in hybrid materials. Expanded the defor developing higher temperature and more damage-tolerant of composites. Continued to expand the development of the fundation use of nanomaterials and nanocomposites in aerospace structure.</li> <li><i>FY 2010 Plans:</i> In FY 2010: Explore the connectivity of molecular scale modeling the influence of constituents' properties to properties of fiber reis composites, and metallic composites. Continue investigating in and their influence on component durability. Continue further structure oxidation of high temperature polymer matrix composites.</li> </ul>	rganic, inorganic, and polymer matrix imental knowledge base to exploit the ires. Ing and micromechanics modeling to link inforced composites, ceramic matrix terfacial properties of hybrid materials								
FY 2011 Base Plans: In FY 2011: Impact of incorporation of carbon nanotubes in carb particle incorporation in thermoplastic composites to improve its conditions. Further investigation of the influence on nanoparticle on the high temperature mechanical properties. Continue mode matrix and fiber in fiber reinforced composites.	crystallization rate in filament winding e networks within amorphous materials								
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A									
MAJOR THRUST: Perform research in metallic, ceramic and hybrid at temperatures above 1000C.	materials to understand their properties	12.505	12.872	13.779	0.000	13.779			
FY 2009 Accomplishments: In FY 2009: Investigated nano-laminates and nanocomposites f vehicle structures. Explored the interaction between chemistry a interfaces of these nanoscale structures. Further explored the p	and mechanics in the surfaces and								

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Se</i>	ciences	<b>PROJECT</b> 612306: <i>Ma</i>	aterials	terials			
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
multifunctional structural metals for power systems and space ap multi-scale models to study the response of aerospace alloys ex and cyclical loading. Continued development of an informatics pr of materials' properties data derived from modeling and experime the fundamental science of friction and thermal effects during fric affordable and environmentally sustainable methods to process	posed to corrosive environments rocess to exploit disparate sources entation. Continued research on ction stir processing. Investigated							
FY 2010 Plans: In FY 2010: Expand the investigation of complex laminates for a understanding of failure mechanisms within these novel systems verification of multi-scale equilibrium models to study the respon- environment. Refine the development of the informatics tools to a materials. Evolve the research on the fundamental science of frid friction stir processing to focus on the role of the interface within and alternative mechanisms to rapidly accelerate the processing temperature aerospace materials.	Expand the development and se of the material in a non-equilibrium accelerate the discovery of novel ction and thermal effects during metallic composites. Explore novel							
FY 2011 Base Plans: In FY 2011: Continue optimizing the thermal and mechanical sta materials for air and space applications. Exploit new approaches materials and to enhance performance in harsh thermal environr concepts for developing stronger and more damage-tolerant high Further explore opportunities to reduce system weight and/or siz high temperature performance of aerospace structures.	s to designing hybrid high temperature nents. Further examine innovative n temperature hybrids materials.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A								
MAJOR THRUST: Explore mimetics, natural materials, and natural/s	ynthetic interfaces.	0.000	4.483	5.389	0.000	5.389		

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Scien</i>	ences	<b>PROJECT</b> 612306: <i>Ma</i>	iterials		
B. Accomplishments/Planned Program (\$ in Millions)			1			
	F	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2009 Accomplishments: In FY 2009: Not Applicable.</li> <li>FY 2010 Plans: In FY 2010: Continue manipulating materials to mimic the prop for sensing, maintenance, self-healing, and repair. Expand invi- prey detection schemes as future technology areas. Further pr and photoluminescent characteristics in natural systems for ap Continue to exploit natural materials and natural/synthetic inter 2) synthesize novel materials, 3) evaluate sensors, and 4) eluc Research natural materials' extension into new electronic and assembly of these materials into unique electronic and optical Investigate natural systems in order to develop new synthetic a properties and systems. Continue investigations in extremophi pathways and materials not achievable under standard conditi mechanisms in nature to discover and understand the basic un- be used to either harden or repair natural materials-based dev</li> <li>FY 2011 Base Plans:</li> </ul>	estigating predator avoidance and new robe and manipulate chromophores oplications to military sensor systems. rfaces to: 1) control natural systems, cidate nanotechnology applications. photonic systems by utilizing the self- architectures for ISR applications. avenues to produce unique material ile research to access synthetic ons. Continue work in physical nderlying natural mechanism that could					
In FY 2011: Continue work on manipulating materials to mimic autonomous materials for sensing, maintenance, self-healing a avoidance and new prey detection schemes as future technolo manipulate chromophores and photoluminescent characteristics in natural sensor systems. Continue to exploit natural materials and natu- natural systems, 2) synthesize novel materials, 3) evaluate ser applications.	and repair. Further investigate predator ogy areas. Continue to probe and I systems for applications to military ural/synthetic interfaces to: 1) control					

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 1: Basic Research		, Air Force		<b>R-1 ITEM NO</b> PE 0601102	-	-	ciences	<b>PROJECT</b> 612306: <i>Ma</i>	terials		
B. Accomplishments/Planned Prog	gram (\$ in N	lillions)	I					1			
	g (+						FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Continue research of natural mathematical self-assembly of these maters Surveillance Reconnaissance a to develop new synthetic avenu extremophile research to access conditions. Continue work in ph underlying natural mechanism to devices. FY 2011 OCO Plans: In FY 2011 OCO: N/A	erials into uni pplications. \ es to produc s synthetic p ysical mecha	que electron Will research e unique ma athways and unisms in nat	ic and optica the manipul terial proper materials no ture to discov	al architectur lation of natu ties and syst ot achievable ver and unde	es for Intellig ral systems ems. Furthe e under star erstand the b	gence in order er explore idard pasic					
			Accomplish	ments/Plann	ed Program	s Subtotals	24.104	29.321	32.040	0.000	32.040
C. Other Program Funding Summa	arv (\$ in Mill	ions)									
	<b>, , , , , , , , , ,</b>	<u></u>	FY 2011	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	FY 2010	Base	000	Total	FY 2012	FY 2013	FY 2014	FY 2015		Total Cost
• PE 0602102F: <i>Materials.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602201F: Aerospace Flight	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dynamics.											
• PE 0602203F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Propulsion.											
• PE 0602500F: Multi-Disciplinary	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Space Technology.											
• PE 0602601F: Space	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology.											
• PE 0603211F: Aerospace Structures.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Ju	ustification: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 1: Basic Research		, Air Force	R-1 ITEM NOMENCLATUREPROJECTPE 0601102F: Defense Research Sciences612306: Mat									
C. Other Program Funding Sum	nmary (\$ in Mill	ions)										
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	1	
Line Item • PE 0708011F: Industrial Preparedness.	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	<u>000</u>	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost	
<b>D. Acquisition Strategy</b> Not Applicable.												
E. Performance Metrics Please refer to the Performance Force performance goals and m	-				v Air Force r	esources are	e applied an	d how those	resources a	re contribut	ing to Air	

Exhibit R-2A, RDT&E Project Jus	tification: PE	3 2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 600: Research, Development, Test & Evaluation, Air Force 3A 1: Basic Research			R-1 ITEM NOMENCLATURE     PROJECT       PE 0601102F: Defense Research Sciences     612307: Fluid Mechanics				cs				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
612307: Fluid Mechanics	19.346	25.706	26.800	0.000	26.800	26.226	26.394	27.830	29.182	Continuing	Continuing

#### <u>Note</u>

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 aerodynamics, turbulence, and rotating and internal flows characteristic of turbomachinery flows.

#### B. Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
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 systems.	8.205	8.452	9.348	0.000	9.348
FY 2009 Accomplishments: In FY 2009: Extended efforts to characterize and model fundamental phenomena of high-speed boundary laminar-turbulent transition to include interactions between multiple instability modes. Validated high-fidelity, unsteady numerical simulation methodologies for shock-dominated flows and non-equilibrium effects. Extended strategies for control of excessive heat transfer, unsteadiness, and					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sci</i>	iences	<b>PROJECT</b> 612307: <i>Fl</i>	CT Fluid Mechanics			
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
separation in hypersonic flows to reduce severe local loads on severe phenomena in aerothermodynamic environment and his the goal of reducing thermal protection system complexity and reusability, sustainability, efficiency, and turn time of hypersoni	gh-temperature vehicle materials with increasing performance to improve						
FY 2010 Plans: In FY 2010: Characterize and model fundamental phenomena turbulent transition to include interactions between multiple insi conditions including roughness. Validate high-fidelity, unsteady shock-dominated flows including non-equilibrium effects, lamin grid refinement. Continue exploration of strategies for control o and separation in hypersonic flows to reduce severe local load interactions between severe phenomena in aerothermodynami vehicle materials with the goal of reducing thermal protection s system performance.	ability modes and realistic surface numerical simulation methodologies for ar-turbulent transition and automated f excessive heat transfer, unsteadiness, s on systems. Characterize and model c environment and high-temperature						
FY 2011 Base Plans: In FY 2011: Characterize and model fundamental phenomena including interactions between multiple instability modes in lam influence of realistic surface conditions including roughness, at validation of high-fidelity, unsteady numerical simulation methor including non-equilibrium effects and laminar-turbulent transition control methods via simulation of benchmark canonical probler excessive heat transfer, unsteadiness, and separation in hyper loads on systems. Develop multidisciplinary simulation capabili severe phenomena in aerothermodynamic environment and his	inar-turbulent transition and the olation and surface chemistry. Continue dologies for shock-dominated flows, in and implementation of potential ns. Refine strategies for control of sonic flows to reduce severe local						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research S</i>	ciences				
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY11 OCO: N/A						
MAJOR THRUST: Expand fundamental knowledge of unsteady flow and computational efforts. Study complex flow phenomena related to		9.146	9.393	10.288	0.000	10.288
FY 2009 Accomplishments: In FY 2009: Continued to develop reduced order, closed-loop flo flows of complex geometries and jet engines and identified spect technology. Characterized and modeled promising applications jet engine integration and efficiency for a wider range of flight op predicting and controlling unsteady, vortex-dominated flows on techniques for improving convective heat transfer at all flow scal subsonic and supersonic flight systems.	of flow control techniques to improve berating conditions. Validated tools for UAVs. Continued to develop innovative					
FY 2010 Plans: In FY 2010: Explore reduced order, closed-loop flow control mea complex geometries and flexible structures and identify canonic model promising applications of flow control techniques to optim aerodynamic efficiency for a wider range of flight operating conc and controlling unsteady, vortex-dominated flows on UAVs. Exp multidisciplinary simulation of unsteady fluid-structure interaction	al problems. Characterize and lize fluid-structure interactions and litions. Validate tools for predicting lore scientific issues related to					
FY 2011 Base Plans: In FY 2011: Develop physically accurate descriptions of unstead and highly flexible structures. Derive and assess reduced order that lead to robust, closed-loop flow control approaches. Refine techniques to optimize fluid-structure interactions and aerodyna flight operating conditions. Continue validation of tools for predic	models of canonical flow problems modeling of promising flow control mic efficiency for a wider range of					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research</i> S	Sciences	<b>PROJECT</b> 612307: <i>Fl</i>	ECT 7: Fluid Mechanics				
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
dominated flows on UAVs in a range of scales. Develop numer of unsteady fluid-structure interactions.	rical tools for multidisciplinary simulation							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A								
MAJOR THRUST: Research novel sensing and control mechanism Reynolds Number flight regimes. Expand fundamental knowledge of		0.000	6.268	7.164	0.000	7.164		
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.								
FY 2010 Plans: In FY 2010: Characterize and model sensor-effector systems f and spatial navigation, with emphasis on robust agility at low F information processing mechanisms, including multi-modal ser spatial orientation and optimal flight path guidance. Characteriz to optimize performance capabilities of flexible airfoils, e.g., wit airflow disturbances, Coriolis forces, and wing loading. Develo enable adoption in engineered technology for autonomous or s	Reynolds Numbers. Study sensory hsing, to understand autonomous ze closed-loop control mechanisms th respect to sensing and handling of p and test neuromorphic emulations to							
FY 2011 Base Plans: In FY 2011: Investigate natural flight capabilities applicable to operating in cluttered and/or unpredictable environments. Deve intelligent, autonomous flight control and navigation in multi-ve based upon natural systems of sensing and guidance, with em small UAVs operating in low Reynolds Number regimes. Conti neuromorphic algorithms based upon sensorimotor information in autonomous flight.	elop mathematical approaches for hicle arrays and cooperative swarms, phasis on possible applications to nue to develop mathematical and							

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVI</b> 3600: <i>Research, Development, Test</i> BA 1: <i>Basic Research</i>		, Air Force		<b>R-1 ITEM N</b> PE 0601102			ciences	<b>PROJECT</b> 612307: <i>Flu</i>	id Mechanic	s	
<b>B. Accomplishments/Planned Prog</b>	gram (\$ in M	lillions <u>)</u>									
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A											
			Accomplish	ments/Plann	ed Program	s Subtotals	17.351	24.113	26.800	0.000	26.800
							FY 2009	FY 2010			
Congressional Add: Development ar Research (National Hypersonic Rese			d Design Te	chnologies fo	or Hyperson	ic	1.995	1.593			
FY 2009 Accomplishments: In FY 2009: Continued research develop predictive numerical me	•					ıd					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
				Congre	essional Add	s Subtotals	1.995	1.593			
C. Other Program Funding Summa	nry (\$ in Mill	ions)									
	EV 2000	EV 2040	FY 2011	FY 2011	FY 2011	EV 2042	EV 2042	EV 2044		Cost To	Total Coat
Line Item     PE 0602102F: Materials.	<u>FY 2009</u> 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	<u>0C0</u> 0.000	<u>Total</u> 0.000	<u>FY 2012</u> 0.000	FY 2013 0.000	<u>FY 2014</u> 0.000	<u>FY 2015</u> 0.000	Complete 0.000	0.000
• PE 0602201F: Aerospace Flight Dynamics.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602203F: Aerospace Propulsion.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Ju	istification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACT</b> 3600: <i>Research, Development, Te</i> BA 1: <i>Basic Research</i>		, Air Force		<b>R-1 ITEM N</b> PE 0601102			ciences	<b>PROJECT</b> 612307: <i>Fl</i>	JECT D7: Fluid Mechanics Cost To			
C. Other Program Funding Sum	mary (\$ in Mill	ions)										
Line Item • PE 0603211F: Aerospace Structures.	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u> <u>Base</u>	<u>FY 2011</u> <u>OCO</u>	<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>			
<ul> <li>D. Acquisition Strategy Not Applicable.</li> <li>E. Performance Metrics Please refer to the Performance</li> </ul>											. , .	

Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010			
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 1: Basic Research		n, Air Force		R-1 ITEM NOMENCLATURE PE 0601102F: Defense Research SciencesPROJECT 612308: Propulsion								
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
612308: Propulsion	24.669	32.115	34.022	0.000	34.022	32.772	32.599	34.335	36.057	Continuing	Continuing	

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Research and model space propulsion and power in the areas of chemistry, electronics, miniaturization, and contamination/signature.	10.951	11.576	12.477	0.000	12.477
FY 2009 Accomplishments: In FY 2009: Continued studies of small satellite, microsatellite, and nanosatellite propulsion and investigated plasma dynamics in these thrusters. Investigated high altitude plumes signature and contamination. Continued investigating alternate launch systems using electromagnetic forces. Conducted fundamental component and system level research that leads to introduction of novel multi- use technologies and concepts to achieve multi-functional satellite architectures and development of					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research</i> Se	ciences	<b>PROJECT</b> 612308: <i>Pr</i>	ECT 8: Propulsion				
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
highly efficient power generation/recovery systems (e.g., micro structured thermoelectric units) deeply integrated with thermal Enhanced novel diagnostic techniques for characterization of c harsh, optically thick environments.	management or spacecraft structure.							
FY 2010 Plans: In FY 2010: Continue to research high altitude plume signature formation and optical scattering in geosynchronous orbits. Con systems using electromagnetic forces and beamed energy. Inv plasma propulsion to achieve regenerative power, thereby resu waste heat in satellites. Investigate novel energetic propellants cryogenic propellant performance with non-cryogenic systems. or gel propellants to increase specific impulse in liquid propulsi spray techniques for these novel propellant systems. Further e characterization of combustion instabilities in high pressure, ha	tinue investigating alternate launch estigate electrothermal materials in ilting in higher efficiencies and lower for space propulsion to achieve Introduce nano-energetics in liquid on systems, and investigate various nhance novel diagnostic techniques for							
FY 2011 Base Plans: In FY 2011: Continue the study of novel energetic propellants f aluminum, ammonium borane, silicon, and hydrogen peroxide performance with non-cryogenic propellants in both launch and investigation of nano-energetics in liquid and gel propellants to propulsion systems, and study the dynamic behavior of such sy pressure, and temperature combustion phenomena. Continue using electromagnetic forces and beamed energy. Continue to concepts for nano, micro, and macro satellites, including electr and power regeneration through thermoelectric materials. Continue	to achieve cryogenic propellant I in-space systems. Continue increase specific impulse in liquid ystems, including three-phase, high- investigating alternate launch systems investigate new electric propulsion odeless and propellantless systems,							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research</i> S	Sciences	<b>PROJECT</b> 612308: <i>Pr</i>	<b>JECT</b> 08: Propulsion				
B. Accomplishments/Planned Program (\$ in Millions)	1		1					
		FY 2009 FY 2010		FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A								
MAJOR THRUST: Explore combustion, propulsion, and diagnostic hypersonics. Investigate multi-phase, turbulent reacting flows.	cs in subsonics, supersonics, and	12.920	13.547	14.449	0.000	14.449		
FY 2009 Accomplishments: In FY 2009: Improved laser diagnostic measurement capabilit effects causing and enhancing thermal destabilization of hydro thermodynamic conditions, and prediction methodologies, whi and computationally tractable, for turbulent combustion model bases for how plasmas are used to improve aerodynamic cha Exploited strategies for using alternate hydrocarbon fuels by in into comprehensive combustion models such as large eddy si Conservation-Assured Fuels Initiative, identified surrogate fue and future alternative fuels through chemically simplified chem conversion characteristics of the base fuels.	bocarbon fuels under supercritical ch are both quantitatively accurate s. Further explored the scientific racteristics and propulsive efficiencies. Inserting reduced fuel representations mulations. In support of the Energy Is that represent the behavior of current							
FY 2010 Plans: In FY 2010: Continue improving laser diagnostic measurement molecular transport effects causing and enhancing thermal de supercritical thermodynamic conditions, and prediction method accurate and computationally tractable, for turbulent combustion the coupling between plasma chemistry and fuel combustion of and combustion enhancement by plasmas. Continue exploitat hydrocarbon fuels by inserting reduced fuel representations in	stabilization of hydrocarbon fuels under dologies, which are both quantitatively on models. Initiate research on chemistry to understand ignition							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research S</i>	Sciences	<b>PROJECT</b> 612308: <i>Pr</i>	IECT 08: Propulsion		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>studies of novel propulsion system design based on alternative with respect to performance, environmental impact, cost, and a FY 2011 Base Plans:</li> <li>In FY 2011: Continue improving laser diagnostic measurement molecular transport effects causing and enhancing thermal des supercritical thermodynamic conditions, and prediction method accurate and computationally tractable, for turbulent combustion the coupling between plasma chemistry and fuel combustion cl and combustion enhancement by plasmas. Continue exploitation hydrocarbon fuels by inserting reduced fuel representations int such as large eddy simulations. In support of the Energy Consecontinue studies of novel propulsion system design based on a optimization with respect to performance, environmental impact.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	capabilities, investigations of stabilization of hydrocarbon fuels under ologies, which are both quantitatively on models. Continue research on nemistry to understand ignition on of strategies for using alternate o comprehensive combustion models ervation-Assured Fuels Initiative, llternative fuel properties to achieve					
MAJOR THRUST: Identify, characterize, and bioengineer photosyn microorganisms and their metabolic pathways. <i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.	thetic and/or non-photosynthetic	0.000	6.195	7.096	0.000	7.096
FY 2010 Plans: In FY 2010: Continue researching the biosolar generation of hy and manipulate the metabolic, genetic, and biophysical mecha microbes (algae and cyanobacteria) in generating renewable h algal oil generation as a renewable jet fuel source by bio-prosp	nisms utilized by some photosynthetic ydrogen energy. Begin researching					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research So</i>	ciences	<b>PROJECT</b> 612308: <i>Pr</i>					
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>of algae whose genes may be used to enhance the production biological fuel cells that explore the biophysical and catalytic in transfer between electrodes and microbial materials, enabling biofuels for compact power needs.</li> <li><i>FY 2011 Base Plans:</i> <ul> <li>In FY 2011: Continue to studay biosolar hydrogen to manipula to the hydrogen-generating enzyme by eliminating and/or addi pathways of electron flow and for the oxygen-sensitive inhibitic Continue bio-prospecting research to identify and clone unique metabolically engineer into one strain, optimizing the control a future source of jet fuel. Continue to identify and map the inter controlling and channeling electrons from photosynthesis to th Continue research on microbial fuel cells by exploring and channeling electrons from photosynthesis to the control identify microbial genes involved in extracting electrons from and begin to identify microbial genes involved in extracting electrons from photosynthesis to the control is to identify microbial genes involved in extracting electrons from and begin to identify microbial genes involved in extracting electrons from and begin to identify microbial genes involved in extracting electrons from photosynthesis to the control is to identify microbial genes involved in extracting electrons from and begin to identify microbial genes involved in extracting electrons from photosynthesis to the resultilizing thermophilic enzymes, self-assembly mechanisms, and create novel, resilient pathways for the complete and efficient enhanced compact power production.</li> </ul></li></ul>	the chanisms required for efficient electron the future utilization of complex, impure the future utilization of complex, impure the future utilization of complex, impure ing genes that code for alternative on of the hydrogen-generating enzyme. The algal oil-generating genes that and enhancement of algal oil for use as a action of metabolic pathways involved in e oil-producing pathways in microalgae. Intercent of algal oil for use as a action of metabolic pathways in microalgae. Intercent of algal oil for use as a action of metabolic pathways in microalgae. Intercent of algal biofilms to electrodes, ectrons from the cathode to reduce search on enzymatic fuel cells by tive-site analysis, and bioengineering to							
FY 2011 OCO Plans: In FY 2011 OCO: N/A								
Ассо	mplishments/Planned Programs Subtotals	23.871	31.318	34.022	0.000	34.022		
		FY 2009	FY 2010	]				
		0.798		-				

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIV</b> 3600: Research, Development, Test BA 1: Basic Research		, Air Force		<b>R-1 ITEM NO</b> PE 0601102			ciences	<b>PROJECT</b> 612308: <i>Pro</i>	pulsion		
B. Accomplishments/Planned Prog	gram (\$ in M	illions <u>)</u>	1								
							FY 2009	FY 2010			
Congressional Add: Coal Transform	nation Labora	itory.									
FY 2009 Accomplishments: In FY 2009: Conducted basic re barriers that inhibit rapid comme			•		cus on addre	essing the					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
				Congre	ssional Add	s Subtotals	0.798	0.797			
C. Other Program Funding Summa	arv (\$ in Mill	ions)									
<b>0</b>	_ <b>_</b> _	<b>/</b>	FY 2011	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	<u>FY 2010</u>	Base	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cos
• PE 0602102F: <i>Materials.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0602203F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Propulsion.											
Propulsion. • PE 0602500F: Multi-Disciplinary	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602500F: <i>Multi-Disciplinary Space Technology.</i>		0.000	0.000							0.000	
<ul> <li>PE 0602500F: Multi-Disciplinary Space Technology.</li> <li>PE 0602601F: Space</li> </ul>	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	
• PE 0602500F: <i>Multi-Disciplinary Space Technology.</i>											0.000 0.000 0.000

#### **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-2A, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
APPROPRIATION/BUDGET ACTIN 3600: Research, Development, Tes BA 1: Basic Research		n, Air Force		R-1 ITEM NOMENCLATURE PE 0601102F: Defense Research SciencesPROJECT 612311: Information Sciences				iences	nces		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
612311: Information Sciences	29.698	51.026	53.143	0.000	53.143	52.784	54.630	57.314	60.208	Continuing	Continuing

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Explore basic mechanisms to realize gains in innovative transformational communications technologies, enabling enhancement to its dominance communications using the space medium.	1.000	0.000	0.000	0.000	0.000
<i>FY 2009 Accomplishments:</i> In FY 2009: Continued 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. Monitored the polarization states to verify the predicted long distance stability.					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research</i> S	ciences	PROJECT 612311: Int	ROJECT 2311: Information Sciences		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
FY 2011 Base Plans: In FY 2011: Not Applicable.						
FY 2011 OCO Plans: In FY 2011 OCO: N/A						
MAJOR THRUST: Conduct fundamental research in signals analy surveillance, and targeting capabilities, increased awareness, and		6.129	9.880	12.180	0.000	12.180
FY 2009 Accomplishments: In FY 2009: Studied navigation approaches such as "optical fl the foundation for over-arching methodologies that integrate s inter-communicating networks of sensor resources. Continued technology for hyper-spectral and other diverse data. Studied performance of new wireless mobile, networked communication technical alternatives for feasibility of super-resolution millime	ensing data collected by distributed, I to develop ultra-wide band transmission methodologies for evaluating the ons systems. Studied and assessed					
FY 2010 Plans: In FY 2010: Further study and refine results of selected solid s together with the propagation of partially coherent laser beam Move toward an evaluative assessment of practicality of free-s on reduced or variable beam coherence. Conduct research in reconstruction to effect fusion of diverse sensors under multi-r networks and countermeasures. Continue assessment of tech resolution millimeter and search and rescue imagery.	s through surrogate turbulent media. space optical communication based compressive sensing and image nodal regime and data from sensor					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research</i> S	ciences	PROJECT 612311: Int	formation Sci	ences	
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Conduct further research in innovative sensing and promote the ways and means for integration of electro-optical, r global positioning satellite (GPS) in electromagnetically and phy Scientific issues connected with radar imaging (and target ident advantageous classes of transmit waveforms, for bi-static, mult set-up, together with the needed conceptual mathematics and o and encryption requirements in "free-space" communication lead optics whose solutions provide new methods of sequence key et timing, new basic results in the integration of sensing GPS data Progress in this domain will facilitate confident actions under matutual updating of geo-location and timing data for a group of u seamless cooperation for surveillance, pursuit, and attack.</li> </ul>	radar, ladar, and inertial systems with ysically challenged environments. tification) include the determination of iple-output, or some other distributed computational techniques. Covertness ad to problems of information theory/ encryption. In precision navigation and over multiple platforms are needed. any military scenarios, such as the					
In FY 2011 OCO: N/A MAJOR THRUST: Conduct research in complex systems and algori		22.569	25.318	27.617	0.000	27.617
<ul> <li>and rich information systems supporting battlefield commanders usi</li> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Increased emphasis on investigating first principles including characteristic properties and metrics, and began deverarchitecture analysis tools. Conducted research on brilliant soft for information operations, knowledge mining, and to improve s and control. Continued to develop information operations science intensive systems and networks. Continued developing information adaptive, and expert decision support.</li> </ul>	of software system architectures elopment of automatic software ware agents and other techniques ituational awareness and command ce techniques to exploit information					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research</i> S	Sciences	<b>PROJECT</b> 612311: <i>Ini</i>	<b>DJECT</b> 311: Information Sciences			
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2010 Plans: In FY 2010: Focus studies on developing software-intensive s deep interaction between humans and computers. Begin infor attribution and hardware/software interface security, and conti discovery. Develop fundamental mathematical methods for th dynamic phenomena in networks and the assurance of the as that enable integration of information and processes on networ levels of situation awareness and response.	mation operations research on attack inue research on covert channel e description of local, global, and sociated protocols. Develop techniques						
FY 2011 Base Plans: In FY 2011: Increase emphasis on developing a science of cy systems modeling techniques that incorporate human behavio capture fundamental human-computer interaction. Initiate info diversity. Expand research on how fundamental mathematical reliability and security of existing and future networks. Continu of information integration and fusion that provides for situation predictive response.	oral models into software architectures to ormation operations research on artificial I methods translate into improved ue developing fundamental science						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Evaluate fundamental mechanisms and build m decision-making, including adaptation to non-cooperative interaction	· · ·	0.000	) 11.047	13.346	0.000	13.34	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sc</i>	ciences	<b>PROJECT</b> 612311: <i>Int</i>	formation Sci				
3. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	-	FY 2011 Total		
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Investigate high-order cognitive processes critical solving, with emphasis on the challenges of sustained operation operations under risk, uncertainty, high workload, and fatigue.</li> <li>inform computational approaches to information analysis, incluid of coupled neural oscillation, modulation filtering, and compressinsight into principles of adaptive intelligence. Develop new applin dynamic environments, with emphasis on decision strategies and multi-cultural conflict. Develop the basic research foundation approaches, to understand and anticipate competitive and coor makers in a cross-cultural context.</li> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Continue to investigate high-order cognitive process frameworks to enable, in a principled way, upward scaling of comproaches from simpler to more complex and realistic decision algorithms for applications in reinforcement learning, sequentia and generalization, Bayesian forecasting, and optimization of a new techniques to understand, measure, and control information</li> </ul>	ons in environments that require efficient Elucidate brain mechanisms that may using mathematical representations sive sampling. Seek deeper scientific proaches to optimize problem-solving s for adversarial, multi-dimensional, on, using computational and modeling perative interactions among decision- sses, and explore new mathematical ognitive information processing on-making tasks. Develop and test al sampling, kernel-based classification attentional resources. Develop onal masking to enhance speech							
communication and situational awareness. Investigate the func computationally-based socio-cultural prediction, including scala larger coalitions.								
FY 2011 OCO Plans: In FY 2011 OCO: N/A								
			+					

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVI 3600: Research, Development, Test BA 1: Basic Research		a, Air Force		<b>R-1 ITEM N</b> PE 0601102	-	-	ciences	<b>PROJECT</b> 612311: Info	ormation Sci	iences	
B. Accomplishments/Planned Prog	gram (\$ in M	lillions)	1								
							FY 2009	FY 2010			
							0.000	0.797			
Congressional Add: Process Integration	ted Mechani	sm for Huma	an-Compute	r Collaboratio	on and Coor	dination					
FY 2009 Accomplishments: In FY 2009: Not Applicable.											
FY 2010 Plans: In FY 2010: Enhance fundamen together computers and humans rapidly moves among all compu	s into a singl	e collaborati									
Congressional Add: Safeguarding Er	nd-User milit	ary Software	9				0.000	3.984			
FY 2009 Accomplishments: In FY 2009: Not Applicable.											
FY 2010 Plans: In FY 2010: Conduct fundament of military software.	tal multi-disc	iplinary rese	arch associa	ated with the	further safe	guarding					
				Congre	essional Add	s Subtotals	0.000	4.781			
C. Other Program Funding Summa	ary (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					Cost To	
Line Item	FY 2009	<u>FY 2010</u>	<b>Base</b>	000	<u>Total</u>	<u>FY 2012</u>	FY 2013	<u>FY 2014</u>		<u>Complete</u>	
• PE 0602500F: <i>Multi-Disciplinary Space Technology.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602601F: Space Technology.	0.000										

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Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 1: Basic Research		, Air Force		<b>R-1 ITEM NO</b> PE 0601102			ciences	<b>PROJECT</b> 612311: <i>Inf</i>	ormation Sci	rmation Sciences		
C. Other Program Funding Summa	ary (\$ in Mill	ions <u>)</u>										
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u> <u>Base</u>	<u>FY 2011</u> <u>OCO</u>	<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Cost To</u> <u>Complete</u>	Total Cost	
• PE 0602702F: Command, Control, and Communications.												
• PE 0603410F: Space System Environmental Interactions Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0603500F: <i>Multi-Disciplinary</i> <i>Advanced Development Space</i> <i>Technology.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
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, RDT&E Project Just	tification: PE	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIN 3600: Research, Development, Test BA 1: Basic Research		n, Air Force			IOMENCLA 2F: Defense	<b>TURE</b> Research S		<b>PROJECT</b> 612312: <i>Bic</i>	ological Scie		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
612312: Biological Sciences	9.831	0.000	0.000	0.000	0.000	0.000	0.000	0.000	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Characterize, understand, predict, control, and engineer biomolecular responses induced	5.570	0.000	0.000	0.000	0.000
in organisms by chemical and physical agents of Air Force significance.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research S</i>	ciences	<b>PROJECT</b> 612312: <i>Bi</i>	ological Scie	nces	
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Began to integrate individual computational model deposition in lung and absorption through skin into animal biok animal disposition of single fuel components. Collected data fr materials and began to develop a data base of responses for f on physico-chemical properties of various nanostructures. Coll data and began bioinformatics analyses to identify unique bior levels of radiant exposure. Continued bio-prospecting, bio-eng approaches to the generation of hydrogen fuel by photosynthe engineering research to identify and eliminate pathways that d away from the hydrogen-generating apparatus. Utilized state-or explore, collect, and analyze data with regard to low-dose che and the molecular pathways and profiles mediating the response</li> <li>FY 2010 Plans:</li> <li>In FY 2011 Base Plans:</li> <li>In FY 2011 OCO Plans:</li> <li>In FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: N/A</li> </ul>	tinetic models for predicting whole om biological systems exposed to nano- uture predictive modeling studies based lected direct energy dose-response nolecular profiles responding to specific ineering, and directed-evolution tic microbes and began metabolic rain unnecessary energy equivalents of-the-art tools and techniques to mical and radiation exposure effects,					
MAJOR THRUST: Explore biomimetics, biomaterials, and biointerfanovel sensors, engineering processes, and mechanisms, and the s		4.261	0.000	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Conducted research on manipulating materials to found in skin for maintenance, self-healing, and repair. Expand	• •					

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Exhibit R-2A, RDT&E Project Just	ification: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 1: Basic Research		n, Air Force		<b>R-1 ITEM NO</b> PE 0601102	-	-	iences	<b>PROJECT</b> 612312: <i>Bic</i>	ological Scie	nces	
B. Accomplishments/Planned Pro	gram (\$ in M	lillions)	·					•			
		-					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>and new prey detection scheme biochromophores and biophoto for applications to military sense cellular systems to synthesize r applications. Researched surfa Continued investigations in extr achievable with room temperatu and understand the basic unde repair bio-based devices or car</li> <li><i>FY 2010 Plans:</i> In FY 2010: Not Applicable.</li> <li><i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.</li> <li><i>FY 2011 OCO Plans:</i> In FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	luminescent or systems. E novel materia ce mediated remophile res ure organism rlying biologio	characteristi Exploited bio Is, evaluate cellular diffe search to acc s. Continued cal mechanis	ics in microbi material and biosensors, rentiation as cess biosynth d work in bio sm that could	ial and protein biointerfacia and elucidate a new sense netic pathwar physical meet d be used to	in-based bic al sciences t e bionanote or modality. ys and mate chanisms to either harde	systems o control chnology rials not discover					
			Accomplish	ments/Plann	ed Program	s Subtotals	9.831	0.000	0.000	0.000	0.000
C. Other Program Funding Summ	ary (\$ in Mill	<u>ions)</u>	<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	FY 2009	<u>FY 2010</u>	Base	000	Total	FY 2012	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	Complete	Total Cost
• PE 0602202F: Human	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Effectiveness Applied Research.											
• PE 0602204F: Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

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Exhibit R-2A, RDT&E Project Jus	stification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTI 3600: Research, Development, Tes BA 1: Basic Research		, Air Force		<b>R-1 ITEM NO</b> PE 0601102			ciences	<b>PROJECT</b> 612312: <i>Bic</i>	ological Scie	logical Sciences		
C. Other Program Funding Summ	nary (\$ in Milli	ions)										
Line Item ● PE 0602602F: Conventional	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u> <u>Base</u>	<u>FY 2011</u> <u>OCO</u>	<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Cost To</u> Complete	<u>Total Cost</u>	
Munitions. • PE 0602702F: Command, Control, and Communication.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

#### 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, RDT&E Project Jus	tification: PE	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIN 3600: Research, Development, Tes BA 1: Basic Research		n, Air Force		<b>R-1 ITEM N</b> PE 0601102	• • • • • • • • • • • • • • • • • • • •		ciences	<b>PROJECT</b> 612313: <i>Hu</i>	ıman Perforr		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
612313: Human Performance	14.319	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Probe human sensory systems and perceptions critical for warfighter performance (auditory and visual processes, multi-sensory integration, and sensory biomimetics).	6.021	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Engaged new research methods to characterize requirements for optimal speech communication, including modulation representation and filtering. Developed 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, developed and tested theoretical models					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force	DATE: February 2010							
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research</i> Se				- luman Performance			
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
for bone- and tissue-conducted cochlear excitation in high-noise to understand and forecast cognitive impairments during contin by employing new genomic and brain-monitoring methods to id- susceptibility. Devised new, physiologically accurate quantitativ sleep/wake timing, homeostatic recovery, and re-entrainment to <i>FY 2010 Plans:</i> In FY 2010: Not Applicable.								
FY 2011 Base Plans: In FY 2011: Not Applicable. FY 2011 OCO Plans:								
In FY 2011 OCO: N/A MAJOR THRUST: Evaluate cognition and perception research in co control tasks.	omplex, multi-interaction command and	8.298	0.000	0.000	0.000	0.000		
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Probed human inference and reasoning under undintegration and fusion, and new approaches to ensure robust de extended duty and under rapidly changing, adversarial condition modeling and game theory, to include socio-cultural influences environments for successful response to and prediction of adverse promoted cross-disciplinary contributions from brain science, or computer science.</li> </ul>	ecision-making under continuous, ns. Continued to refine agent-based in competitive or non-cooperative ersary actions. These new efforts							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.								

Exhibit R-2A, RDT&E Project Just	nibit R-2A, RDT&E Project Justification: PB 2011 Air Force								DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research				<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>				PROJECT 612313: Human Performance				
B. Accomplishments/Planned Pro	ogram (\$ in M	lillions)						1				
·	• ·						FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.												
FY 2011 OCO Plans: In FY 2011 OCO: N/A												
			Accomplish	nments/Plann	ed Program	s Subtotals	14.319	0.000	0.000	0.000	0.00	
C. Other Program Funding Summ	<u>ary (\$ in Mill</u>	<u>ions)</u>										
			FY 2011	FY 2011	FY 2011					Cost To		
Line Item • PE 0602202F: Human Effectiveness Applied Research.	<u>FY 2009</u> 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	<u>0C0</u> 0.000	<u>Total</u> 0.000	FY 2012 0.000	<u>FY 2013</u> 0.000	<u>FY 2014</u> 0.000	<u>FY 2015</u> 0.000	<u>Complete</u> 0.000	<u>Total Cos</u> 0.000	
• PE 0602702F: Command, Control, and Communication.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
<b>D. Acquisition Strategy</b> Not Applicable.												
E Performance Metrics												

#### 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, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research								<b>PROJECT</b> 614113: <i>Ex</i>	ECT 3: External Research Programs Interface			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
614113: External Research Programs Interface	11.879	9.701	9.470	0.000	9.470	9.296	9.472	9.838	10.273	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Foster international science and technology cooperation by supporting the Air Force's international strategy mission. Identify and obtain unique foreign research capabilities.	6.443	5.354	5.238	0.000	5.238
<i>FY 2009 Accomplishments:</i> In FY 2009: 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.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010								
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research</i> S	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sciences</i>				<b>PROJECT</b> 614113: <i>External Research Programs Interface</i>				
B. Accomplishments/Planned Program (\$ in Millions)										
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total				
FY 2010 Plans: In FY 2010: Continue to provide centralized cooperation expe technology liaison missions in order to identify and maintain a technology developments. Continue to capitalize on foreign in world-class scientific research. Continue to seek and maintain publications on unique foreign research capabilities. Continue level DoD delegations and provide primary interface to coordin DoD organizations. Continue to assist in Air Force fiscal comr institutes.	wareness of foreign science and vestments by influencing and acquiring access to technical briefs and to support international visits of high- nate international participation among									
FY 2011 Base Plans: In FY 2011: Continue to provide centralized cooperation expetechnology liaison missions in order to identify and maintain a technology developments. Continue to capitalize on foreign in world-class scientific research. Continue to seek and maintain access to trunique foreign research capabilities. Continue to support inter delegations and provide primary interface to coordinate internorganizations. Continue to assist in Air Force fiscal commitments to NATO-affiliated research.	wareness of foreign science and vestments by influencing and acquiring echnical briefs and publications on national visits of high-level DoD ational participation among DoD									
FY 2011 OCO Plans: In FY 2011 OCO: N/A										
MAJOR THRUST: Strengthen science, mathematics, and engined infrastructure in the U.S., thereby strengthening Air Force technical	•	5.436	6 4.347	4.232	0.000	4.232				

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Febr	ruary 2010					
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102F: <i>Defense Research Sc</i>				PROJECT 614113: External Research Programs Interfac				
B. Accomplishments/Planned Program (\$ in Millions)			1						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total			
<ul> <li>FY 2009 Accomplishments: In FY 2009: Supported science, mathematics, and engineering programs at U.S. colleges and universities, including historicall Hispanic serving institutions, and other minority institutions. Incresearch needs throughout civilian scientific community, while best scientific talent to participate in critical Air Force research.</li> <li>FY 2010 Plans: In FY 2010: Continue to support science, mathematics, and en outreach programs at U.S. colleges and universities, including universities, Hispanic serving institutions, and other minority institutions force research needs throughout civilian scientific community, recruiting the best scientific talent to participate in critical Air Force</li> </ul>	y black colleges and universities, creased awareness of Air Force simultaneously identifying/recruiting the gineering research, and educational historically black colleges and stitutions. Increase awareness of Air while simultaneously identifying/								
FY 2011 Base Plans: In FY 2011: Continue to support science, mathematics, and en outreach programs at U.S. colleges and universities, including universities, Hispanic serving institutions, and other minority in Force research needs throughout civilian scientific community, recruiting the best scientific talent to participate in critical Air Fo	historically black colleges and stitutions. Increase awareness of Air while simultaneously identifying/								
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A									
		11.879	9.701	9.470	0.000	9.47			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVI 3600: Research, Development, Test BA 1: Basic Research	<b>R-1 ITEM NO</b> PE 0601102	-	-	iences	<b>PROJECT</b> 614113: <i>Ext</i>	ernal Resea	arch Program	ns Interface			
C. Other Program Funding Summa											
	2 .		<u>FY 2011</u>	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	<u>FY 2010</u>	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	Complete	Total Cost
• PE 0601103D: University	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Research Initiative.											
• PE 0602102F: <i>Materials.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602201F: Aerospace Flight	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dynamics.											
• PE 0602202F: Human	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Effectiveness Applied Research.											
• PE 0602203F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Propulsion.											
• PE 0602204F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Avionics.											
• PE 0602269F: Hypersonic	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology Program.											
• PE 0602500F: <i>Multi-Disciplinary</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Space Technology.											
• PE 0602601F: Space	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology.											
• PE 0602602F: Conventional	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Munitions.											
• PE 0602702F: Command,	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Control and Communication.											

#### 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, RDT&E Budget Item	Justification	: PB 2011 A	ir Force						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research				<b>R-1 ITEM NOMENCLATURE</b> PE 0601103F: <i>University Research Initiatives</i>							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	133.526	141.524	136.297	0.000	136.297	140.273	145.093	147.415	149.702	Continuing	Continuing
615094: University Research Initiatives	133.526	141.524	136.297	0.000	136.297	140.273	145.093	147.415	149.702	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 2009	<u>FY 2010</u>	FY 2011 Base	FY 2011 OCO	<u>FY 2011</u>	<b>Total</b>
Previous President's Budget	137.056	132.249	0.000	0.000		0.000
Current President's Budget	133.526	141.524	136.297	0.000	13	36.297
Total Adjustments	-3.530	9.275	136.297	0.000	13	36.297
<ul> <li>Congressional General Reductions</li> </ul>		0.000				
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000				
<ul> <li>Congressional Rescissions</li> </ul>	0.000	-0.585				
Congressional Adds		9.860				
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000				
Reprogrammings	0.000	0.000				
SBIR/STTR Transfer	0.000	0.000				
Other Adjustments	-3.530	0.000	136.297	0.000	13	36.297
Congressional Add Details (\$ in Millions, and Inclu	udes General Redu	<u>uctions)</u>			FY 2009	FY 2010
Project: 615094: University Research Initiatives						
					0.798	0.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	1	DATE: February 2010	)
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103F: University Research Initiatives		
Congressional Add Details (\$ in Millions, and Includes Ge	neral Reductions)	FY 2009	FY 2010
Congressional Add: Partnership in Innovative Preparation Consortium (SEC).	for Educators and Students (PIPES) and the Space Education		
Congressional Add: High Temperature Hydrogen Energy I	Production.	1.197	0.797
Congressional Add: Battle Space Reducing Military Decision	ion Cycles.	1.277	0.000
Congressional Add: Secure Network Centric Operations.		1.596	1.693
Congressional Add: Aerodynamic Wind Tunnel Upgrade In	nitiative.	1.596	0.000
Congressional Add: Cyber Security Laboratory at Louisiar	na Tech University.	2.991	1.195
Congressional Add: Lean Management System Research	Initaitive at Air Mobility Wing MacDill AFB.	0.798	0.000
Congressional Add: Rapid Prototyping and Nanotechnolog	gy Initiative.	0.798	0.000
Congressional Add: Unmanned Aerial Systems Mission P	lanning and Operation Center.	0.399	2.788
Congressional Add: Cyber Innovation Center (CIC) Resea	arch and Development Seed Fund.	0.000	0.797
Congressional Add: Energy and Sensor Informatics Resea	arch and Transition.	0.000	0.797
Congressional Add: Frank R. Seaver Science and Engine	ering Initiative.	0.000	1.753
	Congressional Add Subtotals for Project: 61	5094 11.450	9.820
	Congressional Add Totals for all Pro	jects 11.450	9.820

#### **Change Summary Explanation**

Note: The FY 2010 President's Budget sumittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

Note: In FY 2010, Congress added \$1.2 million for Cyber Security Research Program/Cyber Security Laboratory, \$2.8 million for Unmanned Aerial Systems Mission Planning and Operation Center, \$0.8 million for Energy and Sensor Informatics Research and Transition, \$1.76 million for Frank R. Seaver Science and Engineering Initiative, \$0.8 million for Cyber Innovation Center (CIC) Research and Development Seed Fund, \$1.7 million for Cybersecurity for Control Networks Research, and \$0.8 million for High Temperature Hydrogen Energy Production Facility.

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Ford	ce	DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103F: <i>University Research Initiatives</i>			
C. Performance Metrics (U) Under Development.				
	UNCLASSIFIED			

Exhibit R-2A, RDT&E Project Jus	stification: PE	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research					EM NOMENCLATURE 01103F: University Research InitiativesPROJECT 615094: University Research Initiatives						
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
615094: University Research Initiatives	133.526	141.524	136.297	0.000	136.297	140.273	145.093	147.415	149.702	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. Accomplishments/Planned Program (\$ in Millions)**

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Promote fundamental, multi- and interdisciplinary science and engineering research projects.	70.144	72.793	75.646	0.000	75.64
<ul> <li>FY 2009 Accomplishments: In FY 2009: Continued funding 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.</li> <li>FY 2010 Plans:</li> </ul>					
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					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103F: University Research Init	tiatives	<b>PROJECT</b> 615094: University Research Initiatives				
B. Accomplishments/Planned Program (\$ in Millions)							
	F	TY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>through the PECASE program. Continue funding of multi-discip prior years.</li> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Continue funding competitive research awards at I underpinning Air Force-related technologies usually not achiev awards. Support and recognize superior academic researchers through the PECASE program. Continue funding of multi-discip prior years.</li> </ul>	J.S. universities to focus on able through typical single investigator in the early stages of their career						
FY 2011 OCO Plans: In FY 2011 OCO: N/A MAJOR THRUST: Support post-graduate, graduate, and undergrad engineering disciplines at U.S. universities.	duate education in science and	39.519	43.932	45.250	0.000	45.25	
FY 2009 Accomplishments: In FY 2009: Continued to award highly competitive NDSEG fell competitive awards for graduate and undergraduate research e under the Awards to Stimulate and Support Undergraduate Re Continued funding for awards made under prior year Departme	experiences including those established search Education (ASSURE) program.						
FY 2010 Plans: In FY 2010: Continue to award highly competitive NDSEG fello awards for graduate and undergraduate research experiences the ASSURE program. Continue funding for awards made under programs.	including those established under						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103F: University Research Init	tiatives	<b>PROJECT</b> 615094: <i>Ur</i>	T Jniversity Research Initiatives		
B. Accomplishments/Planned Program (\$ in Millions)			1			
	F	TY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Continue to award highly competitive NDSEG fello awards for graduate and undergraduate research experiences the ASSURE program. Continue funding for awards made und programs.	including those established under					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Enhance the scientific and engineering researce infrastructure and instrumentation at U.S. universities.	h through advanced education	12.413	14.979	15.401	0.000	15.40
FY 2009 Accomplishments: In FY 2009: Continued to conduct the competition for U.S. univ technology instrumentation and infrastructure to enhance rese the Defense University Research Instrumentation Program (D	arch and educational capabilities under					
FY 2010 Plans: In FY 2010: Continue to conduct the competition for U.S. univertechnology instrumentation and infrastructure to enhance reserve the DURIP.						
FY 2011 Base Plans: In FY 2011: Continue to conduct the competition for U.S. univertechnology instrumentation and infrastructure to enhance reserve the DURIP.						
FY 2011 OCO Plans: In FY 2011 OCO: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103F: <i>University Research I</i>	Initiatives	<b>PROJECT</b> 615094: <i>Ur</i>	niversity Rese	earch Initiativ	/es
B. Accomplishments/Planned Program (\$ in Millions)	· ·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Accompl	lishments/Planned Programs Subtotals	122.076	131.704	136.297	0.000	136.297
				1		
		FY 2009	FY 2010	_		
Congressional Add: Partnership in Innovative Preparation for Educato Space Education Consortium (SEC).	rs and Students (PIPES) and the	0.798	0.000			
FY 2009 Accomplishments: In FY 2009: Conducted multi-disciplinary research associated with and students.	h information network for educators					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
Congressional Add: High Temperature Hydrogen Energy Production.		1.197	0.797			
FY 2009 Accomplishments: In FY 2009: Conducted research to develop methods for hydroge	n production.					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
Congressional Add: Battle Space Reducing Military Decision Cycles.		1.277	0.000			
FY 2009 Accomplishments: In FY 2009: Continued developing decision-making tool that can r of battlefield situational elements and recommendations for respo						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103F: <i>University Research</i>	Initiatives	<b>PROJECT</b> 615094: University Research Initia	
B. Accomplishments/Planned Program (\$ in Millions)	1			
		FY 2009	FY 2010	
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Secure Network Centric Operations.		1.596	1.693	-
FY 2009 Accomplishments: In FY 2009: Conducted research on the security issues in infor components.	rmation technology architectures and			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Aerodynamic Wind Tunnel Upgrade Initiative.		1.596	0.000	_
FY 2009 Accomplishments: In FY 2009: Supported major facility renovation and diagnostic of Arizona Wind Tunnel.	c capability acquisition for the University			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Cyber Security Laboratory at Louisiana Tech L	Jniversity.	2.991	1.195	
<i>FY 2009 Accomplishments:</i> In FY 2009: Focused on new and theoretically sound profiling identification of terrorists and cyber attacks.	-			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103F: <i>University Research</i>	Initiatives	<b>PROJECT</b> 615094: <i>Ur</i>	niversity Research Initiatives
B. Accomplishments/Planned Program (\$ in Millions)			1	
		FY 2009	FY 2010	
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Lean Management System Research Initaitive	at Air Mobility Wing MacDill AFB.	0.798	0.000	-
FY 2009 Accomplishments: In FY 2009: Facilitated civilian education and training program	at the base.			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Rapid Prototyping and Nanotechnology Initiativ	/e.	0.798	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted rapid prototyping and automatic constr printers, stereo lithography machines, or special laser sintering				
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Unmanned Aerial Systems Mission Planning a	nd Operation Center.	0.399	2.788	
FY 2009 Accomplishments: In FY 2009: The Unmanned Aerial Systems (UAS) Mission Pla with the Great Plains Joint Regional Training Center to train Gu and aircraft operation for homeland security and disaster missi- platform owned by the Guard.	uard personnel in mission planning			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103F: <i>University Research Initiatives</i>	<b>PROJECT</b> 615094: <i>Ur</i>	niversity Research Initiatives
B. Accomplishments/Planned Program (\$ in Millions)		1	
	FY 2009	FY 2010	
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.			
Congressional Add: Cyber Innovation Center (CIC) Research and	0.000 Development Seed Fund.	0.797	-
FY 2009 Accomplishments: In FY 2009: Not Applicable.			
<i>FY 2010 Plans:</i> In FY 2010: Utilize seed funds to establish a Research and D	evelopment Cyber Information Center.		
Congressional Add: Energy and Sensor Informatics Research and	0.000 Transition.	0.797	
FY 2009 Accomplishments: In FY 2009: Not Applicable.			
FY 2010 Plans: In FY 2010: Conduct fundamental research in the energy and knowledge and accelerate transitions to military applications.	sensor informatics discipline to increase		
Congressional Add: Frank R. Seaver Science and Engineering Ini	tiative. 0.000	1.753	
FY 2009 Accomplishments: In FY 2009: Not Applicable.			
FY 2010 Plans: In FY 2010: Support the Frank R. Seaver Science and Engine research in science and engineering disciplines.	eering Complex in conducting basic		

Exhibit R-2A, RDT&E Project Ju	ustification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET AC 3600: Research, Development, To BA 1: Basic Research		, Air Force		<b>R-1 ITEM NO</b> PE 0601103		niversity Research Initiatives					
<b>B. Accomplishments/Planned F</b>	Program (\$ in M	illions <u>)</u>									
						ſ	FY 2009	FY 2010			
				Congre	ssional Add	s Subtotals	11.450	9.820			
C. Other Program Funding Sum Line Item • PE 0601102F: Defense Research Sciences. D. Acquisition Strategy Not Applicable.	nmary (\$ in Milli <u>FY 2009</u> 0.000	ons <u>)</u> FY 2010 0.000	FY 2011 Base 0.000	FY 2011 OCO 0.000	FY 2011 <u>Total</u> 0.000	FY 2012 0.000	<u>FY 2013</u> 0.000	<u>FY 2014</u> 0.000	<u>FY 2015</u> 0.000	Cost To Complete 0.000	<u>Total Cos</u> 0.000

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Exhibit R-2, RDT&E Budget Item	xhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force										
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research				<b>R-1 ITEM NOMENCLATURE</b> PE 0601108F: <i>High Energy Laser Research Initiatives</i>							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	e OCO Total FY 2012 FY 2013 FY 2014 FY 2015 Cost							Total Cost
Total Program Element	13.032	12.781	13.198	0.000	13.198	14.258	14.094	14.326	14.554	Continuing	Continuing
615097: High Energy Laser Research Initiatves	13.032	12.781	13.198	0.000	13.198	14.258	14.094	14.326	14.554	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 to stimulate interest in HELs. These educational grants are used for educational tools, scholarships, and summer intern employees in military laboratories. 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. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation.

## **B. Program Change Summary (\$ in Millions)**

	FY 2009	<u>FY 2010</u>	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	13.389	12.834	0.000	0.000	0.000
Current President's Budget	13.032	12.781	13.198	0.000	13.198
Total Adjustments	-0.357	-0.053	13.198	0.000	13.198
<ul> <li>Congressional General Reductions</li> </ul>		-0.053			
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000			
<ul> <li>Congressional Rescissions</li> </ul>	0.000	0.000			
<ul> <li>Congressional Adds</li> </ul>		0.000			
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000			
<ul> <li>Reprogrammings</li> </ul>	0.000	0.000			
<ul> <li>SBIR/STTR Transfer</li> </ul>	0.000	0.000			
<ul> <li>Other Adjustments</li> </ul>	-0.357	0.000	13.198	0.000	13.198

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force		DATE: February 2010
	<b>R-1 ITEM NOMENCLATURE</b> PE 0601108F: <i>High Energy Laser Research Initiatives</i>	

## **Change Summary Explanation**

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

C. Performance Metrics

Under Development.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research				<b>R-1 ITEM N</b> PE 0601108 <i>Initiatives</i>	I <b>OMENCLA<sup>-</sup></b> BF: <i>High Ene</i>		esearch	<b>PROJECT</b> 615097: <i>High Energy Laser Research Initiatves</i>			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
615097: High Energy Laser Research Initiatves	13.032	12.781	13.198	0.000	13.198	14.258	14.094	14.326	14.554	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 to stimulate interest in HELs. These educational grants are used for educational tools, scholarships, and summer intern employees in military laboratories. 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. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation.

## B. Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Improve the fundamental understanding of high-power laser sources, to include solid- state, free electron, and gas laser technologies.	7.887	8.641	8.838	0.000	8.838
FY 2009 Accomplishments: In FY 2009: Completed efforts to conduct fiber laser research focused on single aperture scaling single-mode fibers, and organization of multiple fibers. Completed fundamental research of optically- pumped atomic and molecular gas lasers. Continued research on awarded topics in diode-pumped alkali, free electron, and solid state laser technologies. Initiated interaction to look at promising technology development overseas.					
FY 2010 Plans: 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					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601108F: <i>High Energy Laser R</i> <i>Initiatives</i>	Research	<b>PROJECT</b> 615097: <i>Hi</i> g	gh Energy La	aser Researd	ch Initiatves
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
overseas efforts to leverage international technology advancen FY 2010.	nents. Conduct an MRI proposal call for					
FY 2011 Base Plans: In FY 2011: Complete research efforts on awarded topics in di laser and solid state laser technologies, and evaluate for contin leverage international technology advancements.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Improve the fundamental understanding of bear high power laser applications.	n control technologies as they relate to	2.545	3.404	3.610	0.000	3.610
FY 2009 Accomplishments: In FY 2009: Conducted research on awarded topics for improvite techniques. Continued mitigation of aero-optic effects to enhar to reduce weight, size and complexity of the beam control syste promising technology development overseas.	nce tactical HEL architectures and					
FY 2010 Plans: In FY 2010: Continue mitigation of aero-optic effects to enhance to reduce weight, size, and complexity of the beam control syst leverage international technology advancements.						
FY 2011 Base Plans: In FY 2011: Evaluate for continuation the mitigation of aero-op architectures and the reduction of weight, size, and complexity overseas efforts to leverage international technology advancen	of the beam control system. Continue					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601108F: <i>High Energy Laser R</i> <i>Initiatives</i>	lesearch	<b>PROJECT</b> 615097: <i>High Energy Laser Research Initia</i>				
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 OCO Plans: In FY 2011 OCO: N/A							
MAJOR THRUST: Maintain and evaluate high-fidelity models for H toolkit. Provide for HEL systems level modeling into mission-level		1.850	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Developed a solid state laser model to allow para laser system. Developed a high-fidelity model for HEL system	•						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
FY 2011 Base Plans: In FY 2011: Not Applicable.							
FY 2011 OCO Plans: In FY 2011 OCO: N/A							
MAJOR THRUST: Fund educational grants, through the Directed simulate interest in HEL technologies among students.	Energy Professional Society, intended to	0.750	0.736	0.750	0.000	0.750	
FY 2009 Accomplishments: In FY 2009: Provided scholarships and internships to support Provided grants to Service Academies to stimulate HEL studie support to K-12 school programs to stimulate science and mat and optics. Funded publication of journals and continuing edu field. Conducted a proposal call for FY 2010 for execution and program.							

Exhibit R-2A, RDT&E Project Jus	stification: PB	2011 Air Fc	orce						DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTI 3600: Research, Development, Tes BA 1: Basic Research		, Air Force		<b>R-1 ITEM N</b> PE 0601108 <i>Initiatives</i>			esearch	PROJECT 615097: <i>Hig</i>	r ligh Energy Laser Research Initiatves			
B. Accomplishments/Planned Pr	ogram (\$ in M	illions)						1				
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2010 Plans: In FY 2010: Provide scholars Provide grants to Service Aca to K-12 school programs to sti optics. Fund publication of jou	demies to stim imulate science	ulate HEL s e and math	tudies amon studies, with	g military cao an emphasi	dets. Provid s on lasers a	e support and						
FY 2011 Base Plans: In FY 2011: Provide scholars degrees. Provide grants to Se Provide support to K-12 schoo lasers and optics. Fund public field.	ervice Academ ol programs to	ies to stimul stimulate sc	ate HEL stud	dies among r ath studies,	military cade with an emp	ts. hasis on						
FY 2011 OCO Plans: In FY 2011 OCO: N/A												
			Accomplish	ments/Plann	ed Program	s Subtotals	13.032	12.781	13.198	0.000	13.19	
C. Other Program Funding Sumn	nary (\$ in Mill	ions <u>)</u>										
			FY 2011	FY 2011	FY 2011					Cost To		
Line Item	<u>FY 2009</u>	FY 2010	Base	000	<u>Total</u>	FY 2012	FY 2013			Complete		
• PE 0602890F: High Energy Laser Research.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
• PE 0603444F: Maui Space	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
Surveillance System.												
• PE 0603605F: Advanced Weapons Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
0.000 0.000 0.000 0.000 0.000							0.000	0.000	0.000	0.000	0.000	

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 1: Basic Research		, Air Force		<b>R-1 ITEM NO</b> PE 0601108 <i>Initiatives</i>			<b>PROJECT</b> 615097: <i>High Energy Laser Research Initiatves</i>				
C. Other Program Funding Summa	ary (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	FY 2009	<u>FY 2010</u>	<u>Base</u>	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cos
• PE 0603924F: High Energy											
Laser Advanced Technology											
Program.											
• PE 0602605F: Directed Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Technology.											
• PE 0602120A: Sensors and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Electronic Survivability.			0 000				0 000				0.00
• PE 0602307A: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Weapons Technology.	0.000	0.000	0 000	0.000	0.000	0.000	0.000	0.000	0.000	0 000	0.00
• PE 0602624A: Weapons and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Munitions Technology. • PE 0603004A: Weapons and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Munitions Advanced Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602114N: Power Projection	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Applied Research.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602702E: Tactical	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603175C: Ballistic Missile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Defense Technology.									01000		0100
• PE 0603883C: <i>Ballistic Missile</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Defense Boost Phase Segment.											
• PE 0602651M: Joint Non-Lethal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Weapons Applied Research.											
• PE 0603651M: Joint Non-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Lethal Weapons Technology											
Development.											
D. Acquisition Strategy											
Not Applicable.											

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force								
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 1: Basic Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0601108F: <i>High Energy Laser Research</i> <i>Initiatives</i>	<b>PROJECT</b> 615097: <i>Hi</i> g	gh Energy Laser Research Initiatves					

## **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, RDT&E Budget Item	Justification	: PB 2011 A	ir Force				DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIV</b> 3600: Research, Development, Test BA 2: Applied Research		n, Air Force		R-1 ITEM NOMENCLATURE PE 0602102F: <i>Materials</i>							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	185.583	179.202	137.273	0.000	137.273	135.649	135.476	134.063	136.891	Continuing	Continuing
6201SP: Space Materials Development	31.727	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
624347: Materials for Structures, Propulsion, and Subsystems	79.314	110.280	84.865	0.000	84.865	81.649	80.713	78.623	80.669	Continuing	Continuing
624348: Materials for Electronics, Optics, and Survivability	34.044	33.744	31.687	0.000	31.687	30.746	30.840	30.967	31.255	Continuing	Continuing
624349: Materials Technology for Sustainment	28.853	22.697	16.893	0.000	16.893	19.320	20.022	20.364	20.715	Continuing	Continuing
624915: Deployed Air Base Technology	11.645	12.481	3.828	0.000	3.828	3.934	3.901	4.109	4.252	Continuing	Continuing

## <u>Note</u>

Note: 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, sustainability, availability, 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, RDT&E Budget Item Justification: PB 2011 Air F	orce			DATE:	February 2010	)
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research		EM NOMENCLA 02102F: <i>Materia</i>	-			
B. Program Change Summary (\$ in Millions)						
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011	
Previous President's Budget Current President's Budget	188.152 185.583	127.957 179.202	0.000 137.273	0.000 0.000		0.000 97.273
Total Adjustments	-2.569	51.245	137.273	0.000		37.273
Congressional General Reductions	2.000	0.000	101.210	0.000		
Congressional Directed Reductions		0.000				
<ul> <li>Congressional Rescissions</li> </ul>	0.000	-0.755				
Congressional Adds		52.000				
Congressional Directed Transfers	0.000	0.000				
Reprogrammings     SBIR/STTR Transfer	0.000 0.000	0.000 0.000				
Other Adjustments	-2.569	0.000	137.273	0.000	13	37.273
	- ·- ·			]		
Congressional Add Details (\$ in Millions, and Include		uctions)			FY 2009	FY 2010
Project: 624347: Materials for Structures, Propulsion, and	nd Subsystems					
Congressional Add: Advanced Carbon Fiber Resear	ch and Test Initi	ative.			2.393	0.000
Congressional Add: Advanced Thermal Control Coa	tings for Space J	Applications.			1.596	0.000
Congressional Add: Ceramic Matrix Composite Turb	ine Blade Demo	nstration.			3.989	0.000
Congressional Add: Innovative Polymeric Materials	for Three-Dimen	sional (3-D) Micr	odevice Construction.		1.596	0.000
Congressional Add: Intelligent Manufacturing Initiativ	/e.				2.393	0.000
Congressional Add: Nanocomposites for Lightning F	Protection of Con	nposite Airframe	Structures.		1.197	0.000
Congressional Add: Partnership for Emerging Techn	ologies.				1.596	0.000
Congressional Add: Air Force Minority Leaders Prog	ıram.				7.978	4.780
Congressional Add: Pennsylvania Nanomaterials Co	ommercialization	Center.			1.995	0.797
Congressional Add: Carbon Nanomaterials for Adva	nced Aerospace	Applications.			2.393	0.797
Congressional Add: ONAMI Safer Nanomaterials an	d Nanomanufac	turina			3.989	3.505

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	D/	TE: February 2010	<u>כ</u>		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F: <i>Materials</i>				
Congressional Add Details (\$ in Millions, and Includes Ge	neral Reductions)	FY 2009	FY 2010		
Congressional Add: Consortium for Nanomaterials for Ae	rospace Commerce and Technology (CONTACT).	2.393	3.187		
Congressional Add: Advanced Aerospace Carbon Foam	Heat Exchangers.	1.596	3.187		
Congressional Add: Institute for Science and Engineering	Simulation/Aircraft Fatigue Modeling and Simulation.	3.351	3.585		
Congressional Add: Development of Mobile Wind Turbine	Congressional Add: Development of Mobile Wind Turbine Systems to Power Forward Bases.				
Congressional Add: Aerospace Laser Micro Engineering	Station.	0.000	0.797		
Congressional Add: Hybrid Nanoparticle-based Coolant	Fechnology Development and Manufacturing.	0.000	0.797		
Congressional Add: Lightning Protection Composites.	Congressional Add: Lightning Protection Composites.				
Congressional Add: Ultra-High Temperature Materials for	·Hypersonic Aerospace Vehicles.	0.000	2.390		
	Congressional Add Subtotals for Project: 6243	39.253	28.004		
Project: 624348: Materials for Electronics, Optics, and Surviv	vability				
Congressional Add: Free Electron Laser Capabilities for	Aerospace Microfabrication.	1.117	0.000		
Congressional Add: Gallium Nitride (GaN) RF Power Tec	hnology.	1.596	0.000		
Congressional Add: Plasma-Sphere Array for Flexible Ele	ectronics.	2.792	0.000		
Congressional Add: Diamond Substrate for Cooling of Mi	cro-Electronics.	1.995	0.000		
Congressional Add: High Power Broadly Tunable Middle-	Infrared Laser Sources.	2.393	0.000		
Congressional Add: Light Weight Organic Photovoltaic Te	echnologies.	1.197	0.000		
Congressional Add: Liquid Crystal Laser Eye Protection.		1.596	0.000		
Congressional Add: Optic Band Control Program.		0.798	0.000		
Congressional Add: Large Area, APVT Materials Develop	oment for High Power Devices.	0.798	1.593		
Congressional Add: Gallium Nitride (GaN) Microelectroni	cs and Materials.	0.000	1.593		
Congressional Add: Low-Defect Density Gallium Nitride I	Naterials for High-Performanace Electronics Devices.	0.000	2.788		
Congressional Add: Mid-IR Laser Materials.		0.000	0.797		

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it R-2, RDT&E Budget Item Justification: PB 2011 Air Forc	e D	ATE: February 2010	l
<b>COPRIATION/BUDGET ACTIVITY</b> Research, Development, Test & Evaluation, Air Force Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F: <i>Materials</i>		
Congressional Add Details (\$ in Millions, and Includes G	Seneral Reductions)	FY 2009	FY 2010
	Congressional Add Subtotals for Project: 624	14.282	6.7
Project: 624349: Materials Technology for Sustainment			
Congressional Add: Aircraft Fatigue Modeling and Simu	lation.	2.992	0.
Congressional Add: Science for Sustainment.		1.596	0.
Congressional Add: Accelerated Insertion of Advanced Substitution and Repair.	Materials and Certification for Military Aircraft Structure Material	2.992	1.
Congressional Add: Conducting Polymer Stress and Po	lymer Damage Sensors for Composites.	1.436	2
Congressional Add: LGX High Temperature Acoustic W	ave Sensors.	1.596	1
Congressional Add: Hybrid Materials Integration (HMI).		0.000	1
	Congressional Add Subtotals for Project: 624	10.612	8
Project: 624915: Deployed Air Base Technology			
Congressional Add: <i>Advanced Military Installations that</i> <i>Technologies.</i>	Integrate Renewable Energy and Advanced Energy Storage	3.989	0
Congressional Add: Tactical Shelters Next Generation (	Composite Initiative.	1.596	0
Congressional Add: Fire and Blast Resistant Materials f	or Force Protection.	1.596	3
Congressional Add: Energy Efficiency, Recovery, and G	eneration (ENERGy).	0.000	0
Congressional Add: Fine Water Mist Fire Suppression 7	Fechnology to Replace Halon.	0.000	1
Congressional Add: Partnership for Energy and Automa	tion Technologies.	0.000	1
Congressional Add: Temperature Resistant Landing Pa	d Jet Blast Protection.	0.000	0
	Congressional Add Subtotals for Project: 624	1915 7.181	8
	Congressional Add Totals for all Pro	ects 71.328	51

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force		DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>	

## **Change Summary Explanation**

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

In FY 2010, Congress added \$2.0 million for Accelerated Insertion of Advanced Materials and Certification for Military Aircraft Structure Material Substitution and Repair, \$3.2 million for Advanced Aerospace Carbon Foam Heat Exchangers, \$0.8 million for Aerospace Laser Micro Engineering Station, \$4.8 million for Air Force Minority Leaders Program, \$0.8 million for Carbon Nanomaterials for Advanced Aerospace Applications, \$2.88 million for Conducting Polymer Stress and Polymer Damage Sensors for Composites, \$3.2 million for Consortium for Nanomaterials for Aerospace Commerce and Technology (CONTACT), \$1.2 million for Development of Mobile Wind Turbine Systems to Power Forward Bases, \$1.0 million for Energy Efficiency, Recovery, and Generation (ENERGy), \$2.0 million for Fine Water Mist Fire Suppression Technology to Replace Halon, \$3.2 million for Fire and Blast Resistant Materials for Force Protection, \$1.6 million for Gallium Nitride (GaN) Microelectronics and Materials, \$2.0 million for Hybrid Materials Integration (HMI), \$0.8 million for Hybrid Nanoparticle-based Coolant Technology Development and Manufacturing, \$3.6 million for Institute for Science and Engineering Simulation/Aircraft Fatigue Modeling and Simulation, \$1.6 million for Large Area, APVT Materials Development for High Power Devices, \$3.0 million for Lightning Protection Composites, \$1.6 million for LGX High Temperature Acoustic Wave Sensors, \$2.8 million for Low-Defect Density Gallium Nitride Materials for High-Performance Electronics Devices, \$0.8 million for Mid-IR Laser Materials, \$3.52 million for ONAMI Safer Nanomaterials and Nanomanufacturing, \$1.6 million for Partnership for Energy and Automation Technologies, \$0.8 million for Pennsylvania NanoMaterials Commercialization Center, \$0.8 million for Temperature Resistant Landing Pad Jet Blast Protection, and \$2.4 million for Ultra-High Temperature Materials for Hypersonic Aerospace Vehicles.

C. Performance Metrics Under Development.

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Exhibit R-2A, RDT&E Project Ju	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602102F: <i>Materials</i>				<b>PROJECT</b> 6201SP: Space Materials Development					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost		
6201SP: Space Materials Development	31.727	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing		

#### <u>Note</u>

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 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop materials and processes to dramatically improve performance, durability, and cost of rocket propulsion systems.	3.550	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Downselected the highest payoff materials and processes for high-speed turbopump housings and turbines, ducts, valves, solid rocket casings, insulation, and nozzle throats and develop mechanical property databases for design consideration. Optimized processes to produce full scale test components that can be tested in rocket engine environment. Analyzed material behavior in rocket combustion environment. Focused development plans on pervasive materials requirements to					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		PROJECT 6201SP: Sp	T Space Materials Development		
B. Accomplishments/Planned Program (\$ in Millions)						
	F	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
meet advanced performance and cost goals. Optimized select sub-components for thrust chambers, nozzles, and catalysts.	ted materials, test sub-elements, and					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY2011 OCO: N/A.						
MAJOR THRUST: Develop affordable, advanced structural and no technologies for Air Force space applications.	on-structural materials and processing	16.059	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Optimized initial test methodology and evaluation and life prediction of thermal protection system applications fo high-temperature, long-duration cruise, or access to space em processing development and demonstrate structural integratio in relative environments. Developed materials candidates for for expendable and reusable high-speed vehicle applications is candidate space materials and collect critical data to facilitate	r component operation in robust vironments. Continued materials n into sub-scale components for testing high-temperature protection systems n collaboration with industry. Evaluated					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010					
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>				<b>T</b> Space Materials Developme			
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.								
MAJOR THRUST: Develop materials and M&P technologies to er affordability of surveillance, tracking, targeting, situational awarene communications.	12.118	0.000	0.000	0.000	0.000			
FY 2009 Accomplishments: In FY 2009: Continued to demonstrate processes and process very long wavelength infrared focal plane arrays. Demonstrate wavelength infrared detectors by hybridization and characteriz array. Demonstrated nano-photonic materials for high perform communications and system control architectures. Transition process technologies for application in combined optical and n apertures.	ed processing technology for short zation of 2k x 2k format focal plane nance optoelectronic devices for optical ed suitable materials and materials							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.								
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.								
FY 2011 OCO Plans:								
In FY 2011 OCO: N/A.								

Exhibit R-2A, RDT&E Project Just	ification: PB	2011 Air Fo	rce							DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIV</b> 3600: Research, Development, Test BA 2: Applied Research						PROJECT 6201SP: Sp	T Space Materials Development						
C. Other Program Funding Summa	ary (\$ in Mill	ons)											
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>			
Line Item • PE Not Provided (236): Activity Not Provided	FY 2009 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	<u>0C0</u> 0.000	<u>Total</u> 0.000	FY 2012 0.000	<u>FY 2013</u> 0.000	FY 2014 0.000	FY 2015 0.000	<u>Complete</u> 0.000	<u>Total Cos</u> 0.00		
<u>D. Acquisition Strategy</u> Not applicable.													
E. Performance Metrics Please refer to the Performance Ba Force performance goals and mos	-				Air Force re	esources are	applied an	d how those	resources a	re contributi	ng to Air		

Exhibit R-2A, RDT&E Project Just	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010			
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 2: Applied Research		n, Air Force		PE 0602102F: Materials 624347				PROJECT 624347: Ma and Subsys	laterials for Structures, Propulsion,				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	79.314	110.280	84.865	0.000	84.865	81.649	80.713	78.623	80.669	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, spacecraft, launch systems 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, and lightning strike protection. Concurrently develops advanced processing methods to enable adaptive processing of aerospace materials.

## B. Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop ceramic, ceramic matrix composite, & hybrid materials technologies for performance & supportability improvement in propulsion systems & high temperature aerospace structures.	2.166	11.340	13.073	0.000	13.073
FY 2009 Accomplishments: In FY 2009: Validated advanced ceramic composite performance through testing under real and simulated engine service life conditions. Validated the life prediction model to address time dependent					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		PROJECT 624347: Ma and Subsys	Materials for Structures, Propulsion,			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
degradation associated with environmental exposure. Validate advanced ceramic composite systems with advanced interface <i>FY 2010 Plans:</i> In FY 2010: Complete validation of advanced ceramic compose real and simulated engine service life conditions. Validated the dependent degradation associated with environmental exposur durability of advanced ceramic composite systems with advance Initiate development of new spacecraft catalyst bed systems. A temperature ceramics leading edges in a relevant hypersonic e oxidation models. Validate materials and materials process tee optical and radio frequency communication system apertures.	s via mechanical testing. ite performance through testing under life prediction model to address time re. Validate the severe environment ced interfaces via mechanical testing. Assess performance of ultra high environment (arc jet test rig) and validate						
FY 2011 Base Plans: In FY 2011: Initiate development of new advanced processing life prediction for higher temperature capable CMCs. Continue address time dependent degradation associated with environm the severe environment durability of advanced ceramic composi- via mechanical testing. Initiate development of new CMC syst Continue assessment of thermal protection system materials for suitable materials and materials process technologies for applie frequency communication system apertures.	validation of the life prediction model to ental exposure. Continue validation of site systems with advanced interfaces ems with higher temperature capability. or hypersonic applications. Transition						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop nanostructured materils and nanoscale electromagnetic applications. Develop metamaterials for sensors, a elements.		11.966	19.019	22.109	0.000	22.109	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		<b>PROJECT</b> 624347: Materials for Structures, Pro and Subsystems		opulsion,		
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Developed organic-inorganic metamaterials for Air Fo applications for reduced aperture size, conformal radar, and anten and HPM shielding for electronics hardening. Investigated and developmetamaterials with properties that will enable compact sensor applications of these materials and determine performance enha metamaterial optical elements. Assessed the viability of obtaining with the demonstration of highly integrated subsystems based on rapplications to enable small, highly directional antenna element de</li> <li>FY 2010 Plans:</li> <li>In FY 2010: Explore material concepts for adaptive and multifunctions to improve elements of long-life electrodes. Investigate materials microwave components for reduced size and lightweight application for multifunctional and conformal radio frequency (RF) passive commetamaterials options for electro-optic/infrared (EO/IR) application frequency RF passive microwave applications.</li> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Develop material concepts for adaptive and multifunction frequency RF passive microwave applications.</li> </ul>	na systems. Developed EMI veloped lightweight, conformal lications including: conformal upon complex media. Evaluated incement of fixed frequency metamaterial properties consistent radio frequency integrated circuit evice drivers. ional aircraft structures. Explore d aerial systems (UAS) applications. lectrochemical energy storage s for high frequency passive in to air vehicles. Explore concepts inponents for air vehicles. Explore is. Explore metamaterials for high						
and demonstrate materials and process low-cost processing methor applications. Investigate new materials systems and nano geometres energy storage including development of long-life electrodes. Advances metamaterials-based components. Explore RF/IR photonics for components.	tries to improve electrochemical ance concepts for RF passive						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		PROJECT 624347: Materials for Structures, Pro and Subsystems			opulsion,
B. Accomplishments/Planned Program (\$ in Millions)	· · · ·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Develop fabrication and characterization for EO/IR metamater characterization for emerging metamaterial applications.	ials. Develop fabrication and					
<i>FY 2011 OCO Plans:</i> In FY2011 OCO:						
MAJOR THRUST: Develop lightweight metallic & intermetallic high metals processing technologies to lower costs, increase durability		10.003	15.611	13.903	0.000	13.903
FY 2009 Accomplishments: In FY 2009: Validated materials-damage predictive approach and life extension capability. Developed and validate advance performance propulsion for air platforms with an emphasis on Transitioned computational methods supporting development accelerate insertion of advanced metals into Air Force system	ed metallic materials for enhanced higher temperature capability. and processing to reduce costs to					
FY 2010 Plans: In FY 2010: Continue development and validation of advance enhanced performance propulsion for air platforms with an em Initiate development of an advanced disk system concept for i concepts for air platforms. Initiate development of advanced r engine applications. Initiate development of advanced compu- of materials for advanced propulsion systems. Demonstrate p fabrication of honeycomb and sandwich panels. Validate pane	phasis on higher temperature capability. nsertion into advanced propulsion naterials and processes for liquid rocket tation methods to support modeling processing for thin gage metallics and					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>	URE		<b>PROJECT</b> 624347: Materials for Structures, Propu and Subsystems			
B. Accomplishments/Planned Program (\$ in Millions)			•				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Continue development of an advanced disk system propulsion concepts for air platforms. Continue development of to support modeling of materials for advanced propulsion system demonstration of lightweight metallic thermal protection system hybrid composite material systems. Continue development an models for performance of metallic-based thermal manageme</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: N/A.</li> </ul>	of advanced computation methods ems. Continue development and ms. Optimize fabrication methods for d validation of quantitative, predictive						
MAJOR THRUST: Develop organic matrix composite, hybrid & mu technologies for systems requiring thermal &/or structural manager		7.200	16.252	15.905	0.000	15.905	
<i>FY 2009 Accomplishments:</i> In FY 2009: Validated benefits of life prediction tools for engir Demonstrated improved performance of new material systems applications. Integrated the developed models into commercia advanced material concepts and processes to address therma and air vehicle platforms.	ne and airframe applications. s for space and high-speed vehicle al and industry tools. Developed						
FY 2010 Plans: In FY 2010: Continue to demonstrate improved performance and high-speed vehicle applications. Complete development processes to address weapon and air vehicle platforms. Initia composites systems for solid rocket motor cases. Explore cor tools for engine and airframe applications. Explore lightweight and durable composite and hybrid materials for engine and air durable passive leading edge concepts for responsive access	of advanced material concepts and te investigation of new advanced mposite and hybrid life prediction t, active, adaptive, high temperature, frame applications. Demonstrate						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		PROJECT 624347: Ma and Subsys	Naterials for Structures, Propulsion,			
B. Accomplishments/Planned Program (\$ in Millions)	·						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>carbon fibers modified by carbon nanotubes. Explore novel hig energy and aircraft systems. Explore cost effective, high-condu- thermal management and thermoelectric materials with adaptal Explore high-fidelity, multiscale predictive tools for thermal man material systems and interfaces. Integrate ceramic and metallit subcomponents and evaluate in a relevant space vehicle environed <i>FY 2011 Base Plans:</i> In FY 2011: Transition high-performance material systems for s applications. Develop composite and hybrid life prediction tools Develop lightweight, active, adaptive, high temperature and dur engine and airframe applications. Transition durable passive for access to space. Analyze advanced carbon fibers modified by of high-performance coolants for directed energy and aircraft syste conductivity, lightweight, phase change, thermal management a adaptable, tunable heat transfer properties. Develop high-fidelit thermal management across heterogeneous material systems a of integrated TPS structure in relevant environment (combined <i>FY 2011 OCO Plans:</i> In FY2011 OCO: N/A.</li> </ul>	activity, lightweight, phase change, ole, tunable heat transfer properties. agement across heterogeneous c thermal protection systems (TPS) onment. pace and high-speed vehicle for engine and airframe applications. able composite and hybrid materials for eading edge concepts for responsive carbon nanotubes. Develop novel ems. Explore cost-effective, high- and thermoelectric materials with ty, multiscale predictive tools for and interfaces. Continue assessment						
MAJOR THRUST: Develop materials for fluids, lubricants, aircraft to and specialty treatments to improve system performance and reduc		3.948	3.531	2.950	0.000	2.950	
FY 2009 Accomplishments: In FY 2009: Integrated the analytical models into the coatings of Demonstrated chrome-free primer for corrosion protection syste Continued to demonstrate improved low friction wear, multifunc	ems with a 30-year life expectancy.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		<b>PROJECT</b> 624347: Materials f and Subsystems		rials for Structures, Propulsions	
B. Accomplishments/Planned Program (\$ in Millions)	·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>components. Demonstrated surface treatment candidates for fmicro devices.</li> <li><i>FY 2010 Plans:</i> In FY 2010: Initiate effort to develop combined thermal/friction environments. Develop alternative/renewable energy materials deployed applications, including biomass and other alternative <i>FY 2011 Base Plans:</i> In FY 2011: Continue to develop combined thermal/friction coa environments. Analyze integration and continue development of technologies for agile and adaptive deployed applications.</li></ul>	coating materials for extreme s and technologies for Air Force energy solutions. ting materials for extreme					
FY 2011 OCO Plans: In FY 2011 OCO: N/A.						
<ul> <li>MAJOR THRUST: Develop nanomaterials for munitions &amp; propulsion nanostructured &amp; biological material, &amp; device processing mechanisms</li> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Developed large-scale synthesis and characterization provide stable, triggerable, nanoscale energetic materials for energetic materials for energetic stable, triggerable, nanoscale energetic materials for energetic to support nanoenergetics development. Analyzed the transformation of nanoparticles being investigated as nanoenergetics to evalue Developed microstructural characterization tools to provide robic correlations of nanoenergetic systems. Investigated multi-commic catalyses as controlled release agents for enhancing stability a enhanced ignition.</li> </ul>	sms for systems & sub-systems. Ation of energetic nanomaterials to nhanced energy release munitions, Established modeling and simulation ansport and compartmentalization ate potential environmental impact. Just processing-performance ponent, structured nanoparticle	4.778	14.523	14.199	0.000	14.199

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>			<b>ROJECT</b> 24347: Materials for Structures, Propulsio ad Subsystems			
B. Accomplishments/Planned Program (\$ in Millions)			·				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2010 Plans: In FY 2010: Demonstrate large-scale synthesis and character nanomaterials to provide stable, triggerable, nanoscale energe release munitions, high efficiency air-breathing propulsion, and transport and compartmentalization of nanoparticles being inv potential environmental impact. Analyze microstructural chara processing-performance correlations of nanoenergetic system nanoparticle catalyses as controlled release agents for enhanc providing enhanced ignition. Downselect most promising biolod detection and identification of threat agents.</li> <li>FY 2011 Base Plans: In FY 2011: Demonstrate nanomaterials that provide stable, t materials for enhanced energy release munitions, high efficient to space. Develop understanding of rapid propulsion methods aircraft and space structures, actuators, sensors and electron compartmentalization of nanoparticles being investigated as n environmental impact. Validate microstructural characterization performance correlations of nanoenergetic systems. Continue nanoparticle catalyses as controlled release agents for enhanced in the provide stable as a first and space structures.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO Plans: In FY2011 OCO: N/A.</li> </ul>	etic materials for enhanced energy d access to space. Validate the estigated as nanoenergetics to evaluate acterization tools to provide robust s. Develop multi-component, structured cing stability and storage as well as ogical/nanomaterial hybrids for the riggerable, nanoscale energetic acy air-breathing propulsion, and access for nano bio material devices for ics. Demonstrate the transport and anoenergetics to evaluate potential on tools to provide robust processing- e to develop multi-component, structured cing stability and storage as well as						
MAJOR THRUST: Develop high temperature materials, structures, enable future defense capabilities for prompt global strike concepts		0.000	2.000	2.726	0.000	2.726	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	uary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>			<b>PROJECT</b> 624347: Materials for Structures, Propulsi and Subsystems				
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
FY 2009 Accomplishments: In FY 2009: Not Applicable.								
FY 2010 Plans: In FY 2010: Investigate advanced ceramics, ceramic matrix co concepts for hot structure and thermal protection systems.	omposites, hybrids, and metallic							
FY 2011 Base Plans: In FY 2011: Continue to investigate advanced ceramics, CMCs structure and thermal protection systems.	s, hybrids and metallic concepts for hot							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.								
Accon	nplishments/Planned Programs Subtotals	40.061	82.276	84.865	0.000	84.86		
		FY 2009	FY 2010	]				
Congressional Add: Advanced Carbon Fiber Research and Test In	itiative.	2.393	0.000					
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Adv Initiative.	vanced Carbon Fiber Research and Test							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.								
Congressional Add: Advanced Thermal Control Coatings for Space	Analizationa	1.596	0.000					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		PROJECT 624347: Ma and Subsys	aterials for Structures, Propulsior
B. Accomplishments/Planned Program (\$ in Millions)	'		1	
		FY 2009	FY 2010	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Adv Space Applications.	vanced Thermal Control Coatings for			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Ceramic Matrix Composite Turbine Blade Den	nonstration.	3.989	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Cen Demonstration.	ramic Matrix Composite Turbine Blade			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Innovative Polymeric Materials for Three-Dime	ensional (3-D) Microdevice Construction.	1.596	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Inn Microdevice Construction.	ovative Polymeric Materials for 3-D			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Intelligent Manufacturing Initiative.		2.393	0.000	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		PROJECT 624347: Ma and Subsys	aterials for Structures, Propulsio stems
B. Accomplishments/Planned Program (\$ in Millions)				
		FY 2009	FY 2010	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Inte	elligent Manufacturing Initiative.			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Nanocomposites for Lightning Protection of Co	1.197	0.000	-	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Nar Composite Airframe Structures.	nocomposites for Lightning Protection of			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Partnership for Emerging Technologies.		1.596	0.000	-
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Par	tnership for Emerging Technologies.			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Air Force Minority Leaders Program.		7.978	4.780	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Air	Force Minority Leaders Program.			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		PROJECT 624347: Ma and Subsys	aterials for Structures, Propulsior stems
B. Accomplishments/Planned Program (\$ in Millions)	·			
		FY 2009	FY 2010	]
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Air Fo	rce Minority Leaders Program.			
Congressional Add: Pennsylvania Nanomaterials Commercialization	on Center.	1.995	0.797	-
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Per Commercialization Center.	nnsylvania Nanomaterials			
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Penns Commercialization Center.	sylvania Nanomaterials			
Congressional Add: Carbon Nanomaterials for Advanced Aerospace	a Applications	2.393	0.797	
<i>FY 2009 Accomplishments:</i> In FY 2009: Conducted Congressionally-directed effort for Car Aerospace Applications.				
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally-directed effort for Carbo Aerospace Applications.	on Nanomaterials for Advanced			
Congressional Add: ONAMI Safer Nanomaterials and Nanomanufa	acturing.	3.989	3.505	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for ON Nanomanufacturing.	AMI Safer Nanomaterials and			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		<b>PROJECT</b> 624347: <i>Ma</i> and Subsys	aterials for Structures, Propulsion stems
B. Accomplishments/Planned Program (\$ in Millions)				_
		FY 2009	FY 2010	
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for ONAMI Nanomanufacturing.	Safer Nanomaterials and			
Congressional Add: Consortium for Nanomaterials for Aerospace Co	ommerce and Technology (CONTACT).	2.393	3.187	-
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for CON	ITACT.			
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for CONTA	ACT.			
Congressional Add: Advanced Aerospace Carbon Foam Heat Excha	angers.	1.596	3.187	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Adva Exchangers.	anced Aerospace Carbon Foam Heat			
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Advanc Exchangers.	ced Aerospace Carbon Foam Heat			
Congressional Add: Institute for Science and Engineering Simulation Simulation.	n/Aircraft Fatigue Modeling and	3.351	3.585	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Instit Simulation/Aircraft Fatigue Modeling and Simulation.	ute for Science and Engineering			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		PROJECT 624347: Ma and Subsys	aterials for Structures, Propulsio stems
B. Accomplishments/Planned Program (\$ in Millions)	,			
		FY 2009	FY 2010	
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Institut Simulation/Aircraft Fatigue Modeling and Simulation.	e for Science and Engineering			
Congressional Add: Development of Mobile Wind Turbine Systems	0.798	1.195		
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Dev Systems to Power Forward Bases.				
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Develo Systems to Power Forward Bases.	opment of Mobile Wind Turbine			
Congressional Add: Aerospace Laser Micro Engineering Station.		0.000	0.797	
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Aerosp	pace Laser Micro Engineering Station.			
Congressional Add: Hybrid Nanoparticle-based Coolant Technology FY 2009 Accomplishments: In FY 2009: Not Applicable.	y Development and Manufacturing.	0.000	0.797	

Exhibit R-2A, RDT&E Project Jus	tification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTI</b> 3600: <i>Research, Development, Tes</i> BA 2: <i>Applied Research</i>		, Air Force		<b>R-1 ITEM NO</b> PE 0602102	-	-		PROJECT 624347: Ma and Subsys	aterials for Structures, Propulsion,		
B. Accomplishments/Planned Pro	ogram (\$ in M	illions)									
							FY 2009	FY 2010			
FY 2010 Plans: In FY 2010: Conduct Congres Technology Development and			Hybrid Nand	oparticle-bas	ed Coolant						
Congressional Add: Lightning Prot	ection Compos	sites.					0.000	2.987	-		
FY 2009 Accomplishments: In FY 2009: Not Applicable.	·										
FY 2010 Plans: In FY 2010: Conduct Congres	ssionally-direct	ed effort for	Lightning Pr	otection Cor	nposites.						
Congressional Add: Ultra-High Te	mperature Ma	terials for Hy	personic Ae	rospace Veł	nicles.		0.000	2.390			
FY 2009 Accomplishments: In FY 2009: Not Applicable.											
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congres Hypersonic Aerospace Vehicle		ed effort for	Ultra-High T	emperature	Materials fo	r					
				Congre	ssional Add	s Subtotals	39.253	28.004			
C. Other Program Funding Sumn	narv (\$ in Mill	ions)									
		<u>ionsj</u>	FY 2011	FY 2011	FY 2011					Cost To	
Line Item • PE 0603112F: Advanced	FY 2009 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	0C0 0.000	<u>Total</u> 0.000	FY 2012 0.000	FY 2013 0.000	FY 2014 0.000	FY 2015 0.000	Complete 0.000	<u>Total Cost</u> 0.000
Materials for Weapon Systems.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 2: Applied Research		PE 0602102F: Materials				<b>PROJECT</b> 624347: <i>Materials for Structures, Propulsion,</i> <i>and Subsystems</i>					
C. Other Program Funding Summary (\$ in Millions)											
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	FY 2009	<u>FY 2010</u>	<u>Base</u>	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost
<ul> <li>PE 0603211F: Aerospace Technology Dev/Demo.</li> <li>PE 0603216F: Aerospace Propulsion and Power Technology.</li> </ul>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

**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, RDT&E Project Just	hibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602102F: <i>Materials</i>				<b>PROJECT</b> 624348: Materials for Electronics, Optics, and Survivability						
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	34.044	33.744	31.687	0.000	31.687	30.746	30.840	30.967	31.255	Continuing	Continuing			

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop IR detector & hybrid materials, M&P technologies for performance, affordability, & operational capability of surveillance, tracking, targeting, & situational awareness systems.	1.769	8.234	8.665	0.000	8.665
FY 2009 Accomplishments: In FY 2009: Developed materials and transition strategies for innovative IR materials while continuing to exploit newly emerging material concepts. Validated and optimized IR materials systems capable of responses to more than two discrete wavelengths. Developed candidate materials for three- dimensional growth to exploit unique detection properties of complex IR materials. Developed promising materials growth technologies for nano-scale IR detection materials. Demonstrated epitaxial materials device and substrate improvements. Developed design capability, leveraging new					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		PROJECT 624348: Ma Survivability	ectronics, O	ptics, and	
B. Accomplishments/Planned Program (\$ in Millions)	·		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
materials and substrates. Developed tools and methodologies the power dense devices.	at address the physics of failure for					
In FY 2010: Increase yield of full wafer focal plane arrays of 2k x integrated circuit. Investigate alternative IR materials for long war IR materials in the short wave regime for day-night operation. Mo of materials for low observable (LO), intelligence, surveillance, an applications. Investigate materials constructs for multi-wavelengt multi-wavelength materials schemes. Extend capability of three-o bands and explore tailoring options for diverse mission requireme technology for nano-scale IR detection. Explore options for novel growth technology for nano-scale IR. Advance novel nano-scale	velength detection. Pursue emerging odel and evaluate optical behavior d reconnaissance (ISR), and other h detection. Explore single material, limensional detection to multiple nts. Advance and refine growth nano-scale detection. Scale up					
FY 2011 Base Plans: In FY 2011: Optimize 2k x 2k detector and readout integrated circle packaging for enhanced focal plane array yields. Further IR materials wavelength. Advance mid wavelength materials development for operation for use on low-power systems. Model and evaluate opt ISR, and other applications. Explore enhancing detection capabil Investigate next generation alternative three-dimension schemes. for nano-scale IR. Advance novel nano-scale materials options. C materials optical/IR behavior for LO, ISR, and other applications.	rials development for long high temperature, low-noise ical behavior of materials for LO, ity of three-dimensional detection. Scale up growth technology					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate technologies to enhance effectiveness of aircrews, sensors, viewing systems, and related asse		8.784	5.969	9.115	0.000	9.115

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Febr	DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		PROJECT 624348: Ma Survivability	laterials for Electronics, Optics, and				
B. Accomplishments/Planned Program (\$ in Millions)								
	F	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
FY 2009 Accomplishments: In FY 2009: Developed nonlinear optical limiter materials into of eyes and sensor systems. Developed photorefractive mate passive protection applications. Demonstrated devices using sensor system protection concepts.	erials into device concepts for Air Force							
FY 2010 Plans: In FY 2010: Develop nonlinear optical limiter solid-state mate protection of space-based sensor systems. Investigate photo for increased probability of technology transition to Air Force p Demonstrate electrically tunable liquid crystal filters for sensor thin film concepts for enhanced fixed filter performance. Deve interference and high power microwave shielding for electronic	refractive materials growth repeatability bassive protection applications. r system protection concepts. Develop elop and analyze electromagnetic							
FY 2011 Base Plans: In FY 2011: Demonstrate optimized nonlinear optical limiter n systems. Demonstrate enhanced photorefractive hybrid mater protection applications. Mature improved liquid crystal materia system protection concepts. Demonstrate thin film growth cap performance. Demonstrate semiconductor optical limiter mater in the short wave infrared.	rials concepts for Air Force passive als for photo-tunable devices for sensor pabilities for enhanced fixed filter							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.								
MAJOR THRUST: Develop M&P technologies for power generatio components for surveillance, tracking, targeting, situational awarer		7.640	5.355	5.830	0.000	5.830		

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>	PROJECT 624348: Ma Survivabilit	aterials for El V	lectronics, O	ptics, and		
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2009 Accomplishments: In FY 2009: Optimized materials properties for enhanced device of materials for ultra-lightweight, ultra-high-power aircraft electric airborne lethal and non-lethal directed energy weapons in fighted performance of candidate materials for use in terahertz comport communications and advanced sensors.	cal generator applications, enabling er-sized aircraft. Demonstrated						
FY 2010 Plans: In FY 2010: Explore and identify materials-to-materials interact Refine thin film growth process for improved wide bandgap sem performance issues in materials components of high power mic Develop nanostructured materials using multiple approaches for pulsed power applications.	niconductor material. Investigate rowave directed energy weapons.						
FY 2011 Base Plans: In FY 2011: Develop materials growth adjustment/mitigation m Improve materials and materials applications for increased relia microwave directed energy applications.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop enabling and foundational biotechnologic tagging, tracking, and identification of targets, and bio-integrated elements of targets and bio-integrated ele		1.569	4.960	4.970	0.000	4.970	
FY 2009 Accomplishments: In FY 2009: Developed new biological/nanomaterial hybrids for threat agents. Analyzed efficacy data of using taggants for pre- Incorporated taggants into a variety of media (polymers, paints)	emptive destruction of threat agents.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>				lectronics, O	ptics, and
B. Accomplishments/Planned Program (\$ in Millions)	· · ·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
dispersal. Modeled dispersion properties of polymer-encapsu coverage.	lated taggants for optimal release and					
FY 2010 Plans: In FY 2010: Validate efficacy of using taggants for preemptiv Incorporate taggants into a variety of media (polymer, paints) dispersal. Model dispersion properties of polymer-encapsulat coverage.	for optimal and mission -specific					
FY 2011 Base Plans: In FY 2011: Develop new bio/nano materials that enable broa threats. Integrate delivery methods and bio/nano materials a Demonstrate materials with specific performance characterist	opropriate for specific AF requirements.					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop materials enabling higher performance optical isolators, beam steering, and other high energy laser comp	•	0.000	2.455	3.107	0.000	3.10
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Investigate host/dopant materials for fiber lasers preliminary fiber development. Demonstrate solid state, very options. Investigate very high speed beam steering configura	high speed beam steering materials					

xhibit R-2A, RDT&E Project Justification: PB 2011 Air Force					
<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>	PE 0602102F: <i>Materials</i> 624			ectronics, O	ptics, and
·		1			
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
erials and pursue most promising beam					
complishments/Planned Programs Subtotals	19.762	26.973	31.687	0.000	31.687
t	PE 0602102F: <i>Materials</i> ource components operating in the mid- terials and pursue most promising beam energy laser efficiency and gain.	PE 0602102F: <i>Materials</i> FY 2009 ource components operating in the mid- terials and pursue most promising beam energy laser efficiency and gain.	PE 0602102F: Materials       624348: Massurvivability         FY 2009       FY 2010         ource components operating in the midterials and pursue most promising beam energy laser efficiency and gain.       Figure 100 (100 (100 (100 (100 (100 (100 (100	PE 0602102F: Materials       624348: Materials for El Survivability         FY 2009       FY 2010         FY 2010       Base         ource components operating in the midterials and pursue most promising beam energy laser efficiency and gain.       Image: Component of the midterial of	PE 0602102F: Materials       624348: Materials for Electronics, O Survivability         FY 2009       FY 2010       FY 2011 Base       FY 2011 OCO         ource components operating in the mid- terials and pursue most promising beam energy laser efficiency and gain.       Image: Component of the second secon

	FY 2009	FY 2010
	1.117	0.000
Congressional Add: Free Electron Laser Capabilities for Aerospace Microfabrication.		
FY 2009 Accomplishments:		
In FY 2009: Conducted Congressionally-directed effort for Free Electron Laser Capabilities for Aerospace Microfabrication.		
FY 2010 Plans:		
In FY 2010: Not Applicable.		
	1.596	0.000
Congressional Add: Gallium Nitride (GaN) RF Power Technology.		
FY 2009 Accomplishments:		
In FY 2009: Conducted Congressionally-directed effort for GaN RF Power Technology.		
FY 2010 Plans:		
In FY 2010: Not Applicable.		

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		PROJECT 624348: Ma Survivabilit	aterials for Electronics, Optics, and y
B. Accomplishments/Planned Program (\$ in Millions)	·			
		FY 2009	FY 2010	
Congressional Add: Plasma-Sphere Array for Flexible Electronics.		2.792	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Pla Electronics.	sma-Sphere Array for Flexible			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Diamond Substrate for Cooling of Micro-Elect	ronics.	1.995	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Dia Electronics.	amond Substrate for Cooling of Micro-			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: High Power Broadly Tunable Middle-Infrared I	aser Sources	2.393	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Hig Infrared Laser Sources.				
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Light Weight Organic Photovoltaic Technologi	es.	1.197	0.000	1

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	R-1 ITEM NOMENCLATURE PE 0602102F: <i>Materials</i>		PROJECT 624348: Ma Survivability	aterials for Electronics, Optics, and y
B. Accomplishments/Planned Program (\$ in Millions)				
		FY 2009	FY 2010	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Ligh Technologies.	nt Weight Organic Photovoltaic			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Liquid Crystal Laser Eye Protection.		1.596	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Liqu	uid Crystal Laser Eye Protection.			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Optic Band Control Program.		0.798	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Opt	ic Band Control Program.			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Large Area, APVT Materials Development for I	High Power Devices.	0.798	1.593	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Larg for High Power Devices.	ge Area, APVT Materials Development			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		PROJECT 624348: Ma Survivabilit	aterials for Electronics, Optics, ar y
B. Accomplishments/Planned Program (\$ in Millions)				
		FY 2009	FY 2010	
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Large High Power Devices.	e Area, APVT Materials Development for			
Congressional Add: Gallium Nitride (GaN) Microelectronics and M	aterials.	0.000	1.593	
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Galliu Materials.	um Nitride (GaN) Microelectronics and			
Congressional Add: Low-Defect Density Gallium Nitride Materials Devices.	for High-Performanace Electronics	0.000	2.788	
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Low- for High-Performanace Electronics Devices.	Defect Density Gallium Nitride Materials			
Congressional Add: Mid-IR Laser Materials.		0.000	0.797	1
FY 2009 Accomplishments: In FY 2009: Not Applicable.				

Exhibit R-2A, RDT&E Project Just	tification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIV</b> 3600: <i>Research, Development, Test</i> BA 2: <i>Applied Research</i>		, Air Force		<b>R-1 ITEM NO</b> PE 0602102	-	URE		PROJECT 624348: Ma Survivability	624348: Materials for Electronics, Optic			
B. Accomplishments/Planned Pro	ogram (\$ in M	lillions)	1				I					
		<b>r</b>					FY 2009	FY 2010				
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congres	sionally-direct	ted effort for	Mid-IR Lase	er Materials.								
				Congre	ssional Add	s Subtotals	14.282	6.771				
C. Other Program Funding Summ	ary (\$ in Mill	ions)	FY 2011	FY 2011	FY 2011					Cost To		
Line Item	FY 2009	FY 2010	Base	OCO	Total	FY 2012	FY 2013	FY 2014	FY 2015		Total Cost	
• PE 0603112F: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Materials for Weapon Systems.												
• PE 0602202F: <i>Human</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Effectiveness Applied Research.												
• PE 0602204F: Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0603211F: Aerospace Technology Dev/Demo.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0603231F: Crew Systems and Personnel Protection	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

## **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, RDT&E Project Justification: PB 2011 Air Force										oruary 2010				
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 2: Applied Research		n, Air Force						<b>PROJECT</b> 624349: <i>Ma</i>	CT Materials Technology for Sustainment					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost			
624349: Materials Technology for Sustainment	28.853	22.697	16.893	0.000	16.893	19.320	20.022	20.364	20.715	Continuing	Continuing			

#### <u>Note</u>

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 nonmetallic 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop sensing and life prediction technologies to identify damage and characterize the health of aging structures, propulsion systems, and low-observable materials and structures.	6.716	3.012	5.079	0.000	5.079
FY 2009 Accomplishments: In FY 2009: Demonstrated novel NDI/E methods and techniques to detect and track damage in a wide variety of materials and components for aerospace systems. Demonstrated NDI/E technologies for inspection of thick (multi-layer) aging aircraft structures with complex geometries. Developed sensing technology to detect changes in temperature, strain, pressure, and vibration to enable on-demand health status of turbine engines, aircraft structures, wiring systems, and thermal protection systems.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		PROJECT 624349: Materials Te			chnology for Sustainment		
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>FY 2010 Plans: In FY 2010: Advance novel sensing methods and techniques materials and components for aerospace systems. Augment rextensive applications and potential alternative damage modes development of sensing technology to detect changes in materiate other factors that detrimentally affect aerospace systems. Develop and demonstrate novel LO point inspection probes to performance.</li> <li>FY 2011 Base Plans: In FY 2011: Demonstrate advanced sensing methods and tect other materials and components for aerospace systems. Demonstrate advanced sensing methods and tect other materials on aerospace structures. Demonstrate sensing term aterial properties, damage evolution, and other factors that definite affordable prognosis approaches for life capability. Demonstrate novel LO point inspection probes to experimente.</li> <li>FY 2011 OCO Plans:</li> </ul>	nulti-layer sensing capabilities to more s on aerospace structures. Augment rial properties, damage evolution, and velop materials-damage predictive inagement and life extension capability. enable rapid assessment of LO material hniques to detect and track damage to onstrate augmented multi-layer sensing chnologies that detect changes in letrimentally affect aerospace systems. cycle management and life extension nable rapid assessment of LO material							
In FY 2011 OCO: N/A. MAJOR THRUST: Develop support capabilities, information, and p materials in the production and repair of systems components and		5.040	4.944	5.140	0.000	5.14		
FY 2009 Accomplishments: In FY 2009: Validated advanced techniques to evaluate corros emerging materials used in operationally fielded Air Force syst and processes technologies to repair Air Force legacy systems	sion and erosion resistance of new and tems. Evaluated advanced materials							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research			<b>PROJECT</b> 624349: <i>Ma</i>	aterials Tech	terials Technology for Sustainmer		
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
Air Force systems. Developed test methods and techniques t processes, such as the application of residual stress on the su metals, to support studies and point design solutions that will o components on Air Force systems. Demonstrated and transiti maintainability of advanced LO materials and designs, such as door edges and seals, and multifunctional systems.	Irface of steel and other structural extend the life of specific structural oned technologies for improved						
FY 2010 Plans: In FY 2010: Evaluate advanced materials and processes tech systems and test failure limits for emerging Air Force systems methods and techniques to understand the effects of in-servic processes, such as the application of residual stress on the su metals, to support studies and point design solutions that will of components on Air Force systems. Demonstrate and transition maintainability and life cycle cost of advanced LO materials ar mold-line, applique, door edges and seals, and multifunctional laboratory test methods to evaluate and characterize candidat material behavior suitable for use in space applications.	Develop and demonstrate test e environments and materials inface of steel and other structural extend the life of specific structural in technologies for improved and designs, such as conductive outer- systems. Develop and demonstrate						
FY 2011 Base Plans: FY 2011: Evaluate advanced materials and processes technol and test failure limits for emerging Air Force systems. Develo techniques to understand the effects of in-service environmen application of residual stress on the surface of steel and other point design solutions that will extend the life of specific struct Demonstrate and transition technologies for improved maintai materials and designs, such as conductive outer-mold-line, filr and multifunctional systems. Develop and demonstrate labora	p and demonstrate test methods and ts and materials processes, such as the structural metals, to support studies and ural components on Air Force systems. nability and life cycle cost of advanced ns, coatings, assess panel treatments						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>			aterials Techi	nology for Su	ıstainment
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
characterize candidate space materials for properties and mat applications.	erial behavior suitable for use in space					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop support capabilities, information, and part provide electronic and structural failure analysis of component		6.485	6.296	6.674	0.000	6.674
FY 2009 Accomplishments: In FY 2009: Performed quick response failure analysis and m acquisition organization, depot system materials failures, and to ensure system availability and safety of flight. Developed a protection technologies and procedures for emerging avionics test methodologies for analyzing structural failures of emerging Developed advanced wiring materials technologies to replace technologies for emerging weapons systems.	provide advanced materials solutions dvanced electrostatic discharge subsystems. Demonstrated advanced g materials for Air Force systems.					
FY 2010 Plans: In FY 2010: Perform quick response failure analysis and material acquisition organization, depot system materials failures, and ensure system availability and safety of flight. Develop advant technologies and procedures for emerging avionics subsystem methodologies for analyzing structural failures of emerging materials technologies to replace aging wiring for emerging weapons systems.	provide advanced materials solutions to ced electrostatic discharge protection ns. Demonstrate advanced test aterials for Air Force systems. Develop					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>			T Materials Technology for Sustainm		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Perform quick response failure analysis and material acquisition organization, depot system materials failures, and presure system availability and safety of flight. Develop advance technologies and procedures for emerging avionics subsystem methodologies for analyzing structural failures of emerging materials technologies to replace aging wiring for emerging weapons systems.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A.</li> </ul>	provide advanced materials solutions to ced electrostatic discharge protection ns. Demonstrate advanced test iterials for Air Force systems. Develop	18.241	14.252	16.893	0.000	16.89
		FY 2009	FY 2010	]		
Congressional Add: Aircraft Fatigue Modeling and Simulation. FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Airc FY 2010 Plans:	craft Fatigue Modeling and Simulation.	2.992				
In FY 2010: Not Applicable.		4 500	0.000	-		
		1.596	0.000			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force	xhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research			<b>PROJECT</b> 624349: <i>Ma</i>	aterials Technology for Sustainme	
B. Accomplishments/Planned Program (\$ in Millions)			1		
		FY 2009	FY 2010		
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Scie	ence for Sustainment.				
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.					
Congressional Add: Accelerated Insertion of Advanced Materials a Structure Material Substitution and Repair.	nd Certification for Military Aircraft	2.992	1.992		
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Acc Materials and Certification for Military Aircraft Structure Materia					
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Accele and Certification for Military Aircraft Structure Material Substitu					
Congressional Add: Conducting Polymer Stress and Polymer Dam	age Sensors for Composites.	1.436	2.868	-	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Cor Damage Sensors for Composites.	nducting Polymer Stress and Polymer				
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Condu Damage Sensors for Composites.	ucting Polymer Stress and Polymer				
Congressional Add: LGX High Temperature Acoustic Wave Senso	rs.	1.596	1.593		

Exhibit R-2A, RDT&E Project Jus	tification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIV</b> 3600: <i>Research, Development, Tes</i> BA 2: <i>Applied Research</i>		, Air Force		<b>R-1 ITEM N</b> PE 0602102	-	URE		<b>PROJECT</b> 624349: <i>Ma</i>	aterials Tech	nology for Si	ustainment
B. Accomplishments/Planned Pro	ogram (\$ in M	illions)						1			
							FY 2009	FY 2010	]		
FY 2009 Accomplishments: In FY 2009: Conducted Cong Sensors.	ressionally-dire	ected effort f	for LGX High	n Temperatu	re Acoustic \	Vave					
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congres Sensors.	sionally-direct	ed effort for	LGX High T	emperature	Acoustic Wa	ve					
Congressional Add: Hybrid Materia	als Integration	(HMI).					0.000	1.992			
FY 2009 Accomplishments: In FY 2009: Not Applicable.											
FY 2010 Plans: In FY 2010: Conducted Congi	ressionally-dire	ected effort f	for Hybrid Ma	aterials Integ	ration (HMI)						
				Congre	ssional Add	s Subtotals	10.612	8.445			
C. Other Program Funding Summ	nary (\$ in Milli	ons)	EV 2044	EV 2044	EV 2044					Cost To	
Line Item	FY 2009	FY 2010	FY 2011	<u>FY 2011</u> OCO	FY 2011	FY 2012	FY 2013	FY 2014	EV 2015	<u>Complete</u>	Total Cost
• PE 0603112F: Advanced	0.000	0.000	<u>Base</u> 0.000	0.000	<u>Total</u> 0.000	0.000	<u>FT 2013</u> 0.000	<u>FT 2014</u> 0.000	0.000	0.000	0.000
Materials for Weapons Systems.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603211F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology Dev/Demo.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>D. Acquisition Strategy</b> Not Applicable.											

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		_	DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>	<b>PROJECT</b> 624349: <i>Ma</i>	aterials Technology for Sustainment

## **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-2A, RDT&E Project Jus	tification: PE	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research							<b>PROJECT</b> 624915: <i>De</i>	ployed Air B	ase Technol	logy	
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
624915: Deployed Air Base Technology	11.645	12.481	3.828	0.000	3.828	3.934	3.901	4.109	4.252	Continuing	Continuing

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop deployable infrastructure airbase technologies to reduce airlift and manpower requirements, setup times, and sustainment costs in support of AEF operations.	2.026	2.160	1.911	0.000	1.911
FY 2009 Accomplishments: In FY 2009: Analyzed and demonstrated renewable power technologies applicable to deployed forces. Demonstrated advanced integrated power technologies. Evaluated and developed mitigation for high temperature effects on operating surfaces. Demonstrated and analyzed nondestructive inspection of airfield surface evaluation technologies.					
FY 2010 Plans: 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.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	3600: Research, Development, Test & Evaluation, Air Force PE 0602102F: Materials		PROJECT 624915: <i>De</i>	eployed Air Base Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Developed and demonstrated deployable applicat and conversion of solar power for deployed applications. Deve of candidate high temperature operating surface materials. De autonomous nondestructive inspection of airfield surface evalu	eloped and optimized performance veloped and improved remote and					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop affordable technologies to provide force deployed warfighters and infrastructure.	e protection and survivability to AEF	2.438	1.756	1.917	0.000	1.917
FY 2009 Accomplishments: In FY 2009: Developed and demonstrated methodologies to cl agents and continue to develop supporting fire suppression tec and analyzed combined technologies for fire fighter effectivene resilient structural materials and methodologies for improved p Developed and demonstrated effectiveness of innovative defea and high energy threats.	hnologies for crash/rescue. Developed ss. Validated and demonstrated rotection of structures and inhabitants.					
FY 2010 Plans: In FY 2010: Analyze fire suppression agents using methodologies and infrastructure. Investigate novel, cost-effective technologies optimize developed technologies. Investigate novel structural in deployed warfighters and infrastructure, using methodologies of conduct experiments to verify effectiveness for defeat of IED and Transition mature defeat technologies and investigate emergin microbes and develop effective methodologies to capture biolo applications.	es for fire fighter effectiveness and materials and technologies to support leveloped for protection. Analyze and nd high energy threat technologies. g threats. Explore functions of					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		<b>PROJECT</b> 624915: <i>De</i>	Deployed Air Base Technology		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Develop and optimize fire suppression agents usi warfighters and infrastructure. Develop novel cost effective tee in deployed environments. Develop novel structural materials warfighters and infrastructure using methodologies developed Develop and optimize techniques and materials for defeat of n threats. Analyze functions of microbes and develop effective r processes for use in Air Force applications, such as sensing a Evaluate design and performance of microbial-based technolo</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A.</li> </ul>	chnologies for fire fighter effectiveness and technologies to support deployed for protection from emerging threats. new and evolving IED and high energy methodologies to capture biological and development of solid state materials.	4.464	3.916	3.828	0.000	3.82
70001		4.404	0.910	5.020	0.000	5.02
		FY 2009	FY 2010			
Congressional Add: Advanced Military Installations that Integrate F Storage Technologies.	Renewable Energy and Advanced Energy	3.989	0.000			
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Adv	-					
Integrate Renewable Energy and Advanced Energy Storage T	echnologies.					
Integrate Renewable Energy and Advanced Energy Storage T FY 2010 Plans: In FY 2010: Not Applicable.	echnologies.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>		<b>PROJECT</b> 624915: <i>De</i>	eployed Air Base Technology
B. Accomplishments/Planned Program (\$ in Millions)				
		FY 2009	FY 2010	]
Congressional Add: Tactical Shelters Next Generation Composite	Initiative.			
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Tac Composite Initiative.	ctical Shelters Next Generation			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Fire and Blast Resistant Materials for Force P	rotection.	1.596	3.187	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Fire Protection.	e and Blast Resistant Materials for Force			
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Fire a Protection	nd Blast Resistant Materials for Force			
Congressional Add: Energy Efficiency, Recovery, and Generation	(ENERGy).	0.000	0.996	
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for ENER	RGy.			
Congressional Add: Fine Water Mist Fire Suppression Technology	to Replace Halon.	0.000	1.992	-

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602102F: <i>Materials</i>			eployed Air Base Technology	
B. Accomplishments/Planned Program (\$ in Millions)			1		
		FY 2009	FY 2010	]	
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.					
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Fine to Replace Halon.	Water Mist Fire Suppression Technology				
Congressional Add: Partnership for Energy and Automation Tech	nologies.	0.000	1.593	-	
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally-directed effort for Partn Technologies.	nership for Energy and Automation				
Congressional Add: Temperature Resistant Landing Pad Jet Blas	t Protection.	0.000	0.797		
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort forTemp Protection.	perature Resistant Landing Pad Jet Blast				
	Congressional Adds Subtotals	7.181	8.565	1	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force							DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602102F: <i>Materials</i>				<b>PROJECT</b> 624915: <i>Deployed Air Base Technology</i>			
C. Other Program Funding Summ	nary (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>						
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<b>Complete</b>	Total Cos
• PE 0603112F: Advanced Materials for Weapon Systems.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D. Acquisition Strategy											
Not Applicable.											
E. Performance Metrics		· -		<i></i>							
Please refer to the Performance E Force performance goals and most					Air Force re	esources are	applied an	d how those	resources a	re contributi	ng to Air

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Exhibit R-2, RDT&E Budget Item						DATE: February 2010					
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: <i>Aerospace Vehicle Technologies</i>							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	119.544	138.563	144.699	0.000	144.699	149.062	145.609	149.835	152.533	Continuing	Continuing
622401: Structures	36.902	44.307	44.224	0.000	44.224	47.570	55.857	57.457	58.474	Continuing	Continuing
622403: Flight Controls and Pilot- Vehicle Interface	32.169	28.752	39.283	0.000	39.283	39.679	37.755	38.841	39.532	Continuing	Continuing
622404: Aeromechanics and Integration	50.473	65.504	61.192	0.000	61.192	61.813	51.997	53.537	54.527	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.

bit R-2, RDT&E Budget Item Justification: PB 2011 Air F	DATE:	DATE: February 2010				
<b>ROPRIATION/BUDGET ACTIVITY</b> ): Research, Development, Test & Evaluation, Air Force 2: Applied Research		EM NOMENCLA 02201F: Aerospa	25			
rogram Change Summary (\$ in Millions)						
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011	
Previous President's Budget	123.036	127.129	0.000	0.000		0.000
Current President's Budget	119.544	138.563	144.699	0.000		4.699
Total Adjustments	-3.492	11.434	144.699	0.000	14	4.699
Congressional General Reductions		0.000				
Congressional Directed Reductions		0.000				
Congressional Rescissions	0.000	-0.586				
Congressional Adds     Congressional Directed Transform		12.020				
Congressional Directed Transfers	0.000	0.000 0.000				
Reprogrammings     SBIR/STTR Transfer	0.000	0.000				
Other Adjustments	-3.492	0.000	144.699	0.000	14	4.699
Congressional Add Details (\$ in Millions, and Include Project: 622403: Flight Controls and Pilot-Vehicle Interfe				_	FY 2009	FY 201
Congressional Add: Cognitive Unmanned Air Vehicle	es.				0.499	0.
		Cong	ressional Add Subtotal	s for Project: 622403	0.499	0.
Project: 622404: Aeromechanics and Integration						
Congressional Add: Materials Integrity Management Research for the Air Force						2
Congressional Add: Unmanned Air Vehicle Sensor and Maintenance Development Center						3
Congressional Add: Unmanned Aerial System Exploitation						3.
Congressional Add: Unmanned Sense, Track, and Avoid Radar						1.
		Cong	ressional Add Subtotals	s for Project: 622404	0.000	11
			Congressional Add	Fotals for all Projects	0.499	11

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force		DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: Aerospace Vehicle Technologies	

#### **Change Summary Explanation**

Note 1: The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

Note 2: In FY 2010 Congress added \$1.5 million for Unmanned Sense, Track, and Avoid Radar, \$2.98 million for Materials Integrity Management Research for the Air Force, \$3.9 Unmanned Air Vehicle Sensor and Maintenance Development Center, and \$3.48 million for Unmanned Aerial System Exploitation.

(U) C. Performance Metrics Under Development

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
APPROPRIATION/BUDGET ACTIN 3600: Research, Development, Tes BA 2: Applied Research					PROJECT 622401: Structures						
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
622401: Structures	36.902	44.307	44.224	0.000	44.224	47.570	55.857	57.457	58.474	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop an economic service life analysis capability comprised of analysis tools, methodologies, and structural health monitoring schemes.	3.593	25.976	18.820	0.000	18.820
FY 2009 Accomplishments: In FY 2009: Continued 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.					
FY 2010 Plans: 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, enhancing capabilities, component replacement, and technology direction. Continue to incorporate newly developed analysis tools into life prediction and failure analysis. Continue to					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: Aerospace Vehicle Technologies		<b>PROJECT</b> 622401: <i>St</i>					
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
develop failure criteria tools for advanced high temperature air Continue the development of residual stress processes to enh								
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Continue the development of health reasoners for Continue the development of economic service life analysis and future aircraft, enhancing capabilities, component replacement newly developed analysis tools into life prediction and failure a failure criteria tools for advanced high temperature aircraft cond development of residual stress processes to enhance service</li> <li>FY 2011 OCO Plans:</li> </ul>	nd structural design tools for current and t, and technology direction. Incorporate analysis. Complete the development of mponents and concepts. Continue the							
In FY 2011 OCO: N/A MAJOR THRUST: Develop methodologies to reduce the cost and of components and circreft prior to obtaining circularthing as actified		3.322	4.043	6.432	0.000	6.43		
of components and aircraft prior to obtaining airworthiness certification <i>FY 2009 Accomplishments:</i> In FY 2009: Continued development of analytical certification advanced methods, concepts, diagnostic techniques, and man components and airframe design. Initiated development of his analytical certification methodologies that improve airworthine development and testing for aircraft and components subject to	methodologies that incorporate nufacturing technologies into aircraft gh-fidelity and continued real-time ss certification process and reduce							
FY 2010 Plans: In FY 2010: Continue development of analytical certification r methods, concepts, diagnostic techniques, and manufacturing airframe design and mission planning. Initiate the developme	technologies into aircraft components,							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: Aerospace Vehicle Technologies		<b>PROJECT</b> 622401: <i>Sti</i>	<b>JECT</b> 01: <i>Structures</i>				
B. Accomplishments/Planned Program (\$ in Millions)	I		1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
Based on work performed on reliability for structures compone based certification.	nts, initiate development of reliability-							
FY 2011 Base Plans: In FY 2011: Continue development of analytical certification m advanced methods, concepts, diagnostic techniques, and man components and airframe design. Continue the development Initiate increased fidelity of analytical methodologies. Continue certification.	ufacturing technologies into aircraft of response prediction methodologies.							
FY 2011 OCO Plans: In FY 2011 OCO: N/A		10,000	E 000	7.000	0.000	7.00		
MAJOR THRUST: Develop design methods to capitalize on new n integration of various subsystem hardware items and adaptive me <i>FY 2009 Accomplishments:</i> In FY 2009: Continued the development, evaluation, and asse and components that enable the integration of structures. Cor assessment, and ground testing of adaptive structures, subsys into load-bearing structures to create multi-function or ultra-ligh for increased energy efficiencies. Continued development, an of innovative technologies to advance active aero elastic desig aerodynamic flow control technologies, system health reasone Continued characterization of high energy laser concepts. Cor assessment of multi-functional structures to include ground de integrated distributed electronics, and homogeneous sensor in	chanisms into the actual aircraft. essment of design and analysis methods attinued the development, evaluation, etem hardware, and antenna integration ntweight concepts, which provides alysis, evaluation, and simulation in concepts, adaptive structures, rs, and active denial concepts. Intinued development, evaluation, and monstration of energy storage concepts,	16.609	5.806	7.923	0.000	7.92		

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: Aerospace Vehicle Technologies		<b>PROJECT</b> 622401: <i>Sti</i>			
B. Accomplishments/Planned Program (\$ in Millions)	· · ·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Continue the development of multirole aircraft stru development, evaluation, and assessment of design and analy enable the integration of structures with other air vehicle functi well as increase the survivability and performance of future sys evaluation, assessment, and ground testing of adaptive structu- integration into load-bearing structures to create multi-function the development, analysis, and evaluation of innovative techno- design concepts, adaptive structures, aerodynamic flow control handling/maneuverability to enable viable long-range and long vehicle concepts. Continue development, evaluation, and ass include ground demonstration of energy storage concepts and	sis methods and components that ons to reduce cost and weight, as stems. Continued the development, ures, subsystem hardware, and antenna or ultra-lightweight concepts. Continue ologies that integrate active aeroelastic I technologies and aerodynamic endurance air vehicle and micro air essment of multi-functional structures to					
FY 2011 Base Plans: In FY 2011: Continue the development of multirole aircraft stru development, evaluation, and assessment of design and analy enable the integration of structures with other air vehicle functi as increase the survivability and performance of future system and evaluation of innovative technologies that integrate active structures, aerodynamic flow control technologies and aerodyr air vehicle concepts. Develop and demonstrate system level t the need of multifunction, multirole, and adaptive aircraft.	sis methods and components that ons to reduce cost and weight, as well s. Continue the development, analysis, aeroelastic design concepts, adaptive namic handling/maneuverability of micro					
FY 2011 OCO Plans: In FY 2011 OCO: N/A						
MAJOR THRUST: Develop technologies that will permit the structure operate at an extreme altitude, while at sustained speeds greater the structure operate at an extreme altitude.		13.378	8.482	11.049	0.000	11.049

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: Aerospace Vehicle Technologies	PE 0602201F: Aerospace Vehicle 622401: S				
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Further developed technologies that incorporate a for the creation of an integrated air vehicle structure that can wi Technologies will improve durability of existing and future aeros reduced cost and increased life. Incorporated newly developed methods for design and evaluation of hot primary structure.	thstand extreme flight environments. space vehicle structures resulting in					
FY 2010 Plans: In FY 2010: Further develop technologies that incorporate adv for the creation of an integrated air vehicle structure that can wi Technologies will improve durability of existing and future aeros reduced cost and increased life. Complete the development of durable, thermal protections systems. Continue and refine ope concepts. Initiate research to develop and apply these technolo expendable vehicle airframes.	thstand extreme flight environments. space vehicle structures resulting in concepts to advanced, all weather, rationally responsive space access					
FY 2011 Base Plans: In FY 2011: Further develop technologies that incorporate adv. for the creation of an integrated air vehicle structure that can wi Technologies will improve durability of existing and future aeros reduced cost and increased life. Continue to develop structura design and evaluation of hot primary structure. Continue and re access concepts and apply these technologies for lower cost, re airframes.	thstand extreme flight environments. space vehicle structures resulting in concepts and analysis methods for efine operationally responsive space					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
Accon	nplishments/Planned Programs Subtotals	36.902	44.307	44.224	0.000	44.224

Exhibit R-2A, RDT&E Project Jus	tification: PB	2011 Air Fo	rce						DATE: February 2010			
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Tes BA 2: Applied Research C. Other Program Funding Summ		R-1 ITEM NO PE 0602201 Technologies	PROJECT 622401: <i>Structures</i>									
o. other rogram running ourm		101137	FY 2011	FY 2011	FY 2011					Cost To		
Line Item	FY 2009	FY 2010	Base	000	Total	<u>FY 2012</u>	FY 2013	FY 2014	<u>FY 2015</u>		<b>Total Cost</b>	
• PE 0602102F: Materials.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0603112F: Advanced Materials for Weapon Systems.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0603211F: Aerospace Technology Dev/Demo.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

### **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, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 2: Applied Research		R-1 ITEM NOMENCLATUREPROJECTPE 0602201F: Aerospace Vehicle622403: Flight Controls and ParticipationTechnologiesInterface				and Pilot-Ve	lot-Vehicle				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	32.169	28.752	39.283	0.000	39.283	39.679	37.755	38.841	39.532	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop advanced flight control systems, components, and integrated vehicle monitoring systems for both manned and unmanned aircraft.	15.982	7.981	9.562	0.000	9.562
FY 2009 Accomplishments: In FY 2009: 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. Initiated development of control architecture enhancements to enable design for certification to ease validation and verification for complex and adaptive unmanned systems. Initiated development of low-maintenance/fault tolerant control-effector technology for aerospace applications.					
FY 2010 Plans: 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					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: Aerospace Vehicle Technologies		<b>PROJECT</b> 622403: Flight Controls and Pilot-V Interface			
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>configurations for small and micro-sized unmanned air vehicles operations in complex and urban environments.</li> <li><i>FY 2011 Base Plans:</i> <ul> <li>In FY 2011: Further the development, assessment, and certificat mechanization technologies to provide highly reliable operations under adverse environments at significantly reduced size, weigh of control configurations for small and micro-sized unmanned air recovery as well as operations in complex mission environments architecture enhancements to enable design for certification to explex and adaptive unmanned systems.</li> </ul> </li> </ul>	ation of advanced control s for manned and unmanned systems nt, and cost. Continue development r vehicles to enable air deployment/ s. Initiate development of control					
In FY 2011 OCO: N/A MAJOR THRUST: Develop flight control systems that will permit saf	fe interoperability between manned and	8.765	16.304	13.664	0.000	13.664
unmanned aircraft. <i>FY 2009 Accomplishments:</i> In FY 2009: Continued to develop and assess novel control aut algorithms to enable safe and interoperable application of mann systems. Completed reliability and performance analysis of self unmanned vehicle flight formations. Completed development of close-in surveillance of urban environments. Initiated developm vehicles in terminal area and ground operations.	ed and unmanned aerospace -organizing, distributed control of multi- f cooperative control techniques for					
FY 2010 Plans: In FY 2010: Continue to develop and assess novel control auto algorithms to enable safe, interoperable, and integrated applicat						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: Aerospace Vehicle Technologies		PROJECT 622403: Fli Interface	3: Flight Controls and Pilot-Vehicle				
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
aerospace systems. Initiate reliability and performance analys unmanned vehicle packages. Initiate development and asses of heterogeneous systems for close-in surveillance. Initiate te interoperability of unmanned vehicles in airspace, the termina	sment of cooperative control techniques echnology development for the safe							
FY 2011 Base Plans: In FY 2011: Continue to develop and assess novel control au algorithms to enable safe, interoperable, and application integ aerospace systems. Continue reliability and performance and multi-unmanned vehicle packages. Continue development an techniques of heterogeneous systems for close-in surveillance for the safe interoperability of multiple unmanned vehicles in a refueling, and in ground operations. Refine the development and and control technologies for fault/damage tolerance and rapid operations.	aration for manned and unmanned alysis of mixed-initiative control of ad assessment of cooperative control e. Continue technology development airspace, in the terminal area, during and assessment of adaptive guidance							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A								
MAJOR THRUST: Develop tools and methods for capitalizing on a development of future aerospace vehicles.	simulation-based research and	6.923	4.467	16.057	0.000	16.057		
FY 2009 Accomplishments: In FY 2009: Refined network-centric environment to broaden capability. Expanded breadth of simulation analyses in refiner multi-directorate technology trade studies for refined long-rang Conducted simulations to analyze advanced launch and reent concepts.	d net-centric environment to address ge strike and reconnaissance concepts.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: Aerospace Vehicle Technologies		<b>PROJECT</b> 622403: <i>Fli</i> <i>Interface</i>	Flight Controls and Pilot-Vehicle			
B. Accomplishments/Planned Program (\$ in Millions)	· · · · ·	1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2010 Plans: In FY 2010: Refine multi-disciplinary, net-centric simulation equantitative and qualitative assessment of advanced aerospare under realistic mission conditions. Design and conduct simularitary utility and suitability of new technologies and new aero analyses and multi-directorate technology trade studies on stareconnaissance concepts. Continue technology trade studies air vehicles in hostile urban environments.</li> <li>FY 2011 Base Plans: In FY 2011: Refine multi-disciplinary, net-centric simulation equantitative and qualitative assessment of advanced aerospare under realistic mission conditions. Continue to design and conduct assess the military utility and suitability of new technologies a simulation analyses and multi-directorate technology trade studies as space, and reconnaissance concepts. Refine technology trade states are and reconnaissance concepts. Refine technology trade states are and reconnaissance and airbase operations, as well</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	ce vehicle concepts and technologies ation events to evaluate and assess the ospace concepts. Continue simulation rike, transport, access-to-space, and s of small and medium sized unmanned nvironments and models to enable the ce vehicle concepts and technologies induct simulation events to evaluate and nd new aerospace concepts. Refine udies on strike, transport, access-to- le studies of unmanned air vehicles in						
Acco	omplishments/Planned Programs Subtotals	31.670	28.752	39.283	0.000	39.28	
	ſ			1			
		FY 2009	FY 2010				
		0.499	0.000				

Exhibit R-2A, RDT&E Project Just	tification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIN 3600: Research, Development, Tes BA 2: Applied Research	t & Evaluation			R-1 ITEM N PE 0602201 Technologie	F: Aerospac			PROJECT 622403: Flig Interface	ght Controls	and Pilot-Ve	ehicle
B. Accomplishments/Planned Pro	ogram (\$ in M	<u>lillions)</u>					FY 2009	FY 2010			
FY 2009 Accomplishments: In FY 2009: Conducted Congr FY 2010 Plans: In FY 2010: Not Applicable.	essionally-dire	ected effort t	or Cognitive	Unmanned	Air Vehicles						
				Congre	ssional Add	s Subtotals	0.499	0.000			
C. Other Program Funding Summ	nary (\$ in Mill	ions)									
			FY 2011	FY 2011	FY 2011					<u>Cost To</u>	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	Base	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>		Total Cost
• PE 0602202F: <i>Human</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Effectiveness Applied Research.											
• PE 0602204F: Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603211F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Bomber.

• PE 0604015F: Next Generation

0.000

0.000

0.000

### D. Acquisition Strategy

Technology Dev/Demo.

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.

0.000

0.000

0.000

0.000

0.000

0.000

0.000

0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force										DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research					<b>IOMENCLA</b> 1F: <i>Aerospa</i> es			<b>PROJECT</b> 622404: Aeromechanics and Integration				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
622404: Aeromechanics and Integration	50.473	65.504	61.192	0.000	61.192	61.813	51.997	53.537	54.527	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop aerodynamic prediction efforts centered on expanding the design capabilities of manned and unmanned air vehicles.	3.508	2.700	3.487	0.000	3.487
FY 2009 Accomplishments: In FY 2009: 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. Continued to perform mission assessment and develop low-cost unmanned air vehicle concepts to perform tactical surveillance and weapon delivery.					
FY 2010 Plans: 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					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: Aerospace Vehicle Technologies		and Integra	ation		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>to develop and demonstrate flow control to enable fluidic thrust management for an unmanned air vehicle exhaust nozzle. Cor aerodynamic control methods for small unmanned air vehicles.</li> <li><i>FY 2011 Base Plans:</i></li> <li>In FY 2011: Continue to perform mission assessments and develop to perform current and future missions including tactic Continue to develop and assess aeronautical technologies that vehicles in future missions to reduce life cycle costs and decreat of technologies for improved weapon delivery and propulsion sy to develop and demonstrate flow control to enable fluidic thrust</li> </ul>	velop low-cost unmanned air vehicle al surveillance and weapon delivery. enable broad use of unmanned air ase human risk. Continue development ystem performance. Continue work vectoring, area control, and thermal					
management for an unmanned air vehicle exhaust nozzle. Cor aerodynamic control methods for small unmanned air vehicles. FY 2011 OCO Plans:	anue development or innovative					
In FY 2011 OCO: N/A						
MAJOR THRUST: Develop new and improved concepts, designs, a revolutionary capabilities for sustained high-speed re-useable high		21.121	15.044	27.518	0.000	27.518
FY 2009 Accomplishments: In FY 2009: Continued development and assessment of aeros sustained high-speed flight to permit global reach. Initiated adv development. Initiated study of interaction of high-load, high-te and fluid mechanics of inlet.	anced high-speed aero/flight control					
FY 2010 Plans: In FY 2010: Continue development and assessment of aerospa Continue development of techniques for propulsion integration						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: <i>Aerospace Vehicle</i> <i>Technologies</i>		<b>PROJECT</b> 622404: <i>Ae</i>	eromechanics and Integration		ation
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
advanced high-speed aero/flight control and study of aeroelast Continue to characterize high-speed phenomena and develop technologies.						
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Continue development and assessment of aerosp high-speed flight to permit global reach. Continue development and tools to enable shock/boundary layer interaction flow contrispeed propulsion concepts. Continue development and demo speed mixed compression inlet concepts utilizing advanced floexpendable systems. Develop and test inlet variable geometry performance and survivability requirements. Continue to deve control and study of aeroelastic effects for high speed vehicles high-speed phenomena and develop and validate fundamenta through experimental flight techniques in a relevant environme</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: N/A</li> </ul>	at of analysis/design techniques rol and enhanced stability for high instration of high performance high w control technologies for Mach 3+ y concepts that meet balanced mission elop advanced high-speed aero/flight . Continue efforts to characterize I high-speed component technologies					
MAJOR THRUST: Develop new and improved concepts, designs, revolutionary capabilities for re-useable, high altitude vehicle.	and analysis of technologies to enable	6.597	2.060	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Continued development and assessment of aeros usable, space-access vehicle. Enhanced robust design methor for high-speed aeropropulsion. Continued extensive application applying aerothermal computational tools to conceptual, groun traveling at high-speeds. Refined unique high temperature stru- speed re-usable space-access aircraft. Continued multi-discip	odology and integration approaches on and 3-D validation experience in d-tested and flight-tested vehicles uctures and materials in support of high					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: Aerospace Vehicle Technologies	PE 0602201F: Aerospace Vehicle 622404: A				tion
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
speed, high temperature, re-usable air vehicles. Initiated des high-speed, space-access air vehicle system.	gn and test of components of integrated					
<ul> <li>In FY 2010: Continue development and assessment of aeros usable, space-access vehicle. Continue extensive application aerothermal and material response computational tools to cor vehicles traveling at high-speeds. Continue development of n for complex high-speed, high temperature, re-usable air vehic robust hypersonic propulsion design methodology and explora integration approaches. Continue design and testing of comp systems for high-speed space-access vehicles. Initiate work methods for assessing the operability, availability and operation and reusable space access systems.</li> <li><i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.</li> </ul>	and 3-D validation efforts in applying inceptual, ground-tested and flight-tested inulti-disciplinary optimization methods les. Continue development of the ation of advanced hypersonic propulsion onents, subsystems and integrated to develop and validate technologies and					
In FY 2011 OCO: N/A MAJOR THRUST: Develop enabling technologies to allow integra current and future air vehicle platforms.	tion of directed energy weapons into	1.205	2.210	2.533	0.000	2.53
FY 2009 Accomplishments: In FY 2009: Continued development of combined flow contro directed energy system performance on large low-speed aircr						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			_	DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: Aerospace Vehicle Technologies		<b>PROJECT</b> 622404: Ae	romechanic	s and Integra	ation
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Continue development of combined flow control directed energy system performance on large low-speed aircr analysis tools to predict the performance of flow control and a interest to the Air Force.	aft. Initiate work to apply advanced					
FY 2011 Base Plans: In FY 2011: Continue development of combined flow control directed energy system performance on large low-speed aircr analysis tools to predict the performance of flow control and a interest to the Air Force. Initiate development of combined flo for transonic/supersonic aircraft. Extend development of anal control and adaptive optics to higher speed transonic/superso	aft. Continue work to apply advanced daptive optics systems for problems of w control and adaptive optics systems lysis tools for prediction of advanced flow					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
<ul> <li>MAJOR THRUST: Develop and assess technologies for the next</li> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Continued development and assessment of aeror</li> <li>lift systems, transonic, and structural concepts that enable rev</li> <li>designs for rapid global mobility. Continued to develop techn</li> <li>missions for delivery and support aircraft. Optimized configur</li> <li>off and landing performance and high speed cruise. Continued</li> <li>technologies for an advanced mobility platform designed to op</li> <li>provide short take-off capabilities. Continued support to SEC</li> <li>Assured Fuels Initiative). Conducted wind tunnel experiment</li> </ul>	onautical technologies including high- volutionary tanker and transport aircraft ologies that enable multiple roles and ation for trade-off between short take- ed development of inlet and integration perate efficiently at transonic speeds and AF-directed effort (Energy Conservation its and multidisciplinary design concept	18.042	2 31.525	27.654	0.000	27.654

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: Aerospace Vehicle Technologies		<b>PROJECT</b> 622404: <i>Ae</i>	eromechanics	and Integra	ntion
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
natural and artificial laminar boundary layers, alternative fuels integration.	, and very high bypass propulsion					
FY 2010 Plans: In FY 2010: Continue development and assessment of aeron lift systems, transonic configuration optimization, and structura tanker and transport aircraft designs for rapid global mobility. enable multiple roles and missions for delivery and support air off between short take-off and landing performance and high s inlet and integration technologies for an advanced mobility pla transonic speeds and provide short take-off capabilities.	al concepts that enable revolutionary Continue to develop technologies that rcraft. Optimize configuration for trade- speed cruise. Continue development of					
FY 2011 Base Plans: In FY 2011: Continue development and assessment of aeron systems, transonic configuration optimization, and structural of and transport aircraft designs for rapid global mobility. Contin multiple roles and missions for delivery and support aircraft. F short take-off and landing performance and high speed cruise integration technologies for an advanced mobility platform des speeds and provide short take-off capabilities. Continue supp Conservation - Assured Fuels Initiative). Conduct wind tunne of mobility aircraft using 40% less energy through the use of m layers, alternative fuels and very high bypass propulsion integ	concepts that enable revolutionary tanker ue to develop technologies that enable Refine configuration for trade-off between c. Continue development of inlet and signed to operate efficiently at transonic bort to SECAF-directed effort (Energy I experiments to show the feasibility natural and artificial laminar boundary					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
	mplishments/Planned Programs Subtotals	50.473	53.539	61.192	0.000	61.192

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602201F: Aerospace Vehicle Technologies		<b>PROJECT</b> 622404: <i>A</i> e	eromechanics and Integration
B. Accomplishments/Planned Program (\$ in Millions)				
		FY 2009	FY 2010	
Congressional Add: Materials Integrity Management Research for	r the Air Force	0.000	2.987	
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally direct effort in materials Air Force.	s intefrity management research for the			
		0.000	3.900	-
Congressional Add: Unmanned Air Vehicle Sensor and Maintenau	nce Development Center			
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally direct effort in unmanned development center.	ed air vehicle sensor and maintenance			
Congressional Add: Unmanned Aerial System Exploitation		0.000	3.485	
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally direct effort in unmann	ed aerial system exploitation.			
Congressional Add: Unmanned Sense, Track, and Avoid Radar		0.000	1.593	

Exhibit R-2A, RDT&E Project Just	ification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIV</b> 3600: Research, Development, Test BA 2: Applied Research		, Air Force		R-1 ITEM NO PE 0602201 Technologies	F: Aerospac	-		<b>PROJECT</b> 622404: <i>Ae</i>	romechanic	s and Integra	ation
B. Accomplishments/Planned Pro	gram (\$ in N	lillions)	1								
-		-					FY 2009	FY 2010			
FY 2009 Accomplishments: In FY 2009: Not Applicable.											
FY 2010 Plans: In FY 2010: Conduct Congress	sionally direct	effort in unr	nanned ase	nse, track, ar	nd avoid rad	ar.					
				Congre	ssional Add	s Subtotals	0.000	11.965			
C. Other Program Funding Summa	arv (\$ in Mill	ions)									
		<b>/</b>	<u>FY 2011</u>	FY 2011	FY 2011					Cost To	
Line Item • PE 0603211F: Aerospace Technology Dev/Demo.	FY 2009 0.000	FY 2010 0.000	<u>Base</u> 0.000	<u>OCO</u> 0.000	<u>Total</u> 0.000	FY 2012 0.000	<u>FY 2013</u> 0.000	FY 2014 0.000	FY 2015 0.000	Complete 0.000	<u>Total Cost</u> 0.000
• PE 0604015F: Next Generation Bomber.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>D. Acquisition Strategy</b> 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, RDT&E Budget Item	Justification	: PB 2011 A	ir Force						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIV</b> 3600: Research, Development, Tes BA 2: Applied Research		n, Air Force		<b>R-1 ITEM N</b> PE 0602202							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	93.954	93.527	87.452	0.000	87.452	89.331	89.185	92.014	93.763	Continuing	Continuing
621123: Learning and Organizational Collaboration	20.191	19.853	13.214	0.000	13.214	14.193	14.351	14.236	14.116	Continuing	Continuing
625328: Human Dynamics Evaluation	0.000	18.203	16.587	0.000	16.587	15.578	15.224	18.748	19.110	Continuing	Continuing
625329: Sensory Evaluation and Decision Science	0.000	21.910	22.492	0.000	22.492	24.166	24.345	24.555	25.317	Continuing	Continuing
627184: Performance Evaluation in Extreme Environments	54.937	18.486	18.436	0.000	18.436	17.765	17.715	16.318	16.623	Continuing	Continuing
627757: Directed Energy Bioeffects	18.826	15.075	16.723	0.000	16.723	17.629	17.550	18.157	18.597	Continuing	Continuing

#### <u>Note</u>

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 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.

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Fo	orce			DATE:	February 2010	)
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research		EM NOMENCLA 02202F: Human	<b>ATURE</b> Effectiveness Applied R	esearch		
B. Program Change Summary (\$ in Millions)						
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	<u>FY 2011</u>	
Previous President's Budget	93.222	85.122	0.000	0.000		0.000
Current President's Budget	93.954	93.527	87.452	0.000	-	7.452
Total Adjustments	0.732	8.405 0.000	87.452	0.000	8	7.452
<ul> <li>Congressional General Reductions</li> <li>Congressional Directed Reductions</li> </ul>		0.000				
Congressional Rescissions	0.000	-0.395				
Congressional Adds	0.000	8.800				
Congressional Directed Transfers		0.000				
Reprogrammings	0.000	0.000				
SBIR/STTR Transfer	0.000	0.000				
Other Adjustments	0.732	0.000	87.452	0.000	8	7.452
Congressional Add Details (\$ in Millions, and Includes	s General Red	uctions)			FY 2009	FY 2010
Project: 621123: Learning and Organizational Collaborat	tion			-		
Congressional Add: Component Object Model (COM)	) Attitude Contr	ol System Simula	ation/Trainer.	-	1.596	0.000
Congressional Add: Ultra High Resolution Deployable	e Projector for S	Simulation.		-	3.191	0.000
Congressional Add: Center for Unmanned Aerial Sys	tem (UAS) Res	earch, Educatior	n and Training.	-	0.000	6.373
		Cong	gressional Add Subtotals	for Project: 621123	4.787	6.373
Project: 625329: Sensory Evaluation and Decision Scien	nce			-		
Congressional Add: Advanced Night Vision System -	Cockpit Integra	ation.		-	0.000	0.797
		Cong	gressional Add Subtotals	for Project: 625329	0.000	0.797
Project: 627184: Performance Evaluation in Extreme En	vironments			-		
Congressional Add: Imaging Tools for Human Perform	mance Enhance	ement and Diagn	ostics.	-	1.995	1.593
Congressional Add: Homeland Emergency Learning	and Preparedn	ess (HELP) Cent	ter.	-	2.992	0.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	D	ATE: February 2010	)
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness Applied Research</i>		
Congressional Add Details (\$ in Millions, and Includes Gene	ral Reductions)	FY 2009	FY 2010
Congressional Add: Smart View Program (SVP).		0.798	0.000
Congressional Add: Tools and Technologies for Incident and	Consequence Management.	0.798	0.000
	Congressional Add Subtotals for Project: 627	· 184 6.583	1.593
	Congressional Add Totals for all Proj	ects 11.370	8.763
Change Summary Explanation The FY 2010 President's Budget submittal did not reflect FY 201 is not provided because it cannot be made in a relevant manner. In FY 2010, Congress added \$6.4 million for Center for Unmann Vision System - Cockpit Integration, and \$1.6 million for Imaging C. Performance Metrics	ed Aerial System (UAS) Research, Education and Training, \$0.8		

Under Development.

Exhibit R-2A, RDT&E Project Ju	stification: Pl	3 2011 Air F	orce						DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research					<b>IOMENCLA</b> 2F: <i>Human I</i>	<b>TURE</b> Effectiveness	s Applied	PROJECT 621123: Le Collaboratio	123: Learning and Organizational			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
621123: Learning and Organizational Collaboration	20.191	19.853	13.214	0.000	13.214	14.193	14.351	14.236	14.116	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Research enhances Distributed Mission Operations (DMO) and decision dominance environments; identifies requirements for aircrew training in live, immersive environments.	2.060	4.264	4.094	0.000	4.094
FY 2009 Accomplishments: In FY 2009: Performed human factors analyses, 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. Conducted perceptual evaluations of compact immersive display concepts and components. Transitioned results to address broader range of AF mission areas and initiated research on sensory- driven decision making in complex environments.					
FY 2010 Plans: 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					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness A</i> <i>Research</i>	Applied	PROJECT 621123: Le Collaboratio	arning and C on	Organizationa	al
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
correlate with model predictions. Define sensory requirements training environment for DMO. Assess modeling and simulatio models to support immersive training. Conduct research for th reaction trainer system. Enhance training capabilities by popul D cultural content and correlated sensor attribution. NOTE: In increased emphasis in this area.	n requirements for intelligent threat e capabilities needed for a full-threat ating DMO databases with robust 3-					
FY 2011 Base Plans: In FY 2011: Complete analysis of simulation requirements for training. Utilize results to address specific training requirement platforms. Apply sensory-driven decision-making models to bro Evaluate analysis of modeling and simulation efforts for enhance real-time data insertion capabilities into DMO.	s for current and future AF fighter bader range of AF mission areas.					
FY 2011 OCO Plans: In FY 2011 OCO: N/A						
MAJOR THRUST: Continuous learning/aiding strategies to improve command/control, intel, surveillance, and reconnaissance (ISR), un		9.278	5.695	5.785	0.000	5.785
FY 2009 Accomplishments: In FY 2009: Developed tools to permit AF planners and manage methods into readiness parameters and assessment in operational Identified alternative approaches for evaluating the individual, to performance impacts of collaborative, distributed spin-up training instructional development and management methods for conting and explored task allocation methods for performance aiding a Identified functional requirements for instructor operator station evaluated physics-based directed energy threat models for DM	onal training, rehearsal, and exercise. eam, and team of team (coalition) ng and rehearsal. Evaluated integrated nuous learning in LVC contexts nd training in operational contexts. capabilities. Investigated and					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: Human Effectivenes Research	s Applied	PROJECT 621123: Le Collaboratio	al		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>sets to enhance training utility of computer-generated forces. avoidance and rehearsal training combining selected aerodyn and validated visual special effects.</li> <li><i>FY 2010 Plans:</i> In FY 2010: Develop methods for identifying common knowle for individuals, teams, and teams-of-teams in manned and un Develop methods for adapting learning and performance envi team training within and across AF and coalition mission area and storing experience and performance based on operationa. Explore methods that permit persistent learning within and across tactical, operational, and strate Decrease in funding in FY 2010 is due to decreased emphasis </li> <li><i>FY 2011 Base Plans:</i> In FY 2011: Validate methods for identifying common learning adaptation methods that function in both learning and operation. Develop and evaluate alternative approace Develop alternative data aggregation and reporting methods for use these methods to enhance personnel selection, learning, methods for their effectiveness in supporting adaptive readine teams-of teams. Begin validating approaches for LVC training operational, and strategic contexts. </li> </ul>	amic models, directed energy models, dge, skill, and experience requirements manned aerospace environments. ronments to support individual and s. Develop tools for routinely tracking al activities and training events. ross aerospace operational training, lternative approaches for training in egic levels of decision making. NOTE: s in this area. g requirements for teams. Validate onal environments and at the coalition ches to model human performance. for analyzing mission performance and and training. Evaluate these alternative ess training for individuals, teams, and					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	Applied	PROJECT 621123: Le Collaboratio	arning and C on	Organization	al
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Cognitive/behavioral modeling explores applica improvement by enhancing training in mission-relevant environment						
FY 2009 Accomplishments: In FY 2009: Expanded the breadth of the communication mod processing. Integrated knowledge and skill tracking prediction competencies to predict training requirements for Airmen and individualized training programs. Conducted empirical study v Validated semi-automated, adaptive parameter search and mod implemented graphical user interface for performance modera	n system with mission essential demonstrated the ability to produce with skill acquisition/retention models. odel optimization capability and					
FY 2010 Plans: In FY 2010: Create adaptive language comprehension and ge generated communication models. Continue to integrate know system with mission essential competencies to predict individu for Airmen. Broaden ability to model and predict individual difficognitive fatigue across multiple tasks.	wledge and skill tracking prediction ualized, optimized training requirements					
FY 2011 Base Plans: In FY 2011: Integrate mission-relevant task model with langua capability to improve situational awareness of computer-gener studies with skill acquisition/retention models and demonstrate and rehearsal programs. Develop graphical user interface for	rated teammates. Conduct empirical eability to produce optimized training					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
Acco		15.404	13.480	13.214	0.000	13.21

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	Applied	<b>PROJECT</b> 621123: Le Collaboratio	arning and Organizational on
B. Accomplishments/Planned Program (\$ in Millions)				
		FY 2009	FY 2010	
Congressional Add: Component Object Model (COM) Attitude Co	ntrol System Simulation/Trainer.	1.596	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for CC Trainer.	DM Attitude Control System Simulation/			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
		3.191	0.000	
Congressional Add: Ultra High Resolution Deployable Projector for	or Simulation.			
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Ult for Simulation.	tra High Resolution Deployable Projector			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Center for Unmanned Aerial System (UAS) R	Research, Education and Training.	0.000	6.373	
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally-directed effort for a Cen Training.	nter for UAS Research, Education and			
	Congressional Adds Subtotals	4.787	6.373	4

Exhibit R-2A, RDT&E Project Justi	ification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIV				R-1 ITEM NOMENCLATURE PF				PROJECT				
3600: Research, Development, Test	& Evaluation	, Air Force		PE 0602202	F: <i>Human E</i>	ffectiveness	Applied	621123: <i>Lea</i>	-	Organization	al	
BA 2: Applied Research				Research				Collaboratio	n			
C. Other Program Funding Summa	ary (\$ in Mill	ions)										
			<u>FY 2011</u>	FY 2011	<u>FY 2011</u>					Cost To		
Line Item	FY 2009	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost	
• PE 0602233N: Human Systems	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Technology.												
• PE 0602716A: Human Factors	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Engineering Technology.												
• PE 0602785A: Personnel	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Performance and Training												
Technologies.												
• PE 0603231F: Crew Systems	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
and Personnel Protection												
Technology.												
• PE 0603456F: <i>Human</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Effectiveness Adv Tech Dev.												
• PE 0604227F: Distributed	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Mission Training (DMT).												

### **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, RDT&E Project Ju	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research					<b>IOMENCLA</b> 2F: <i>Human E</i>	<b>TURE</b> Effectiveness	s Applied	<b>PROJECT</b> 625328: <i>Hu</i>	<b>OJECT</b> 5328: Human Dynamics Evaluation			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
625328: Human Dynamics Evaluation	0.000	18.203	16.587	0.000	16.587	15.578	15.224	18.748	19.110	Continuing	Continuing	

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Identify methods to enhance mission-essential human capabilities for cyber operations. Develop measures of effectiveness for cyber capabilities.	0.000	6.104	3.971	0.000	3.971
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
FY 2010 Plans: 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.					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	s Applied	<b>PROJECT</b> 625328: <i>Ηι</i>	<b>PROJECT</b> 625328: Human Dynamics Evaluation			
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 Base Plans: In FY 2011: Continue conducting research to enhance perform awareness within cyber operations, including operations support quantifiable measures of effectiveness to demonstrate ability to the behavior of adversaries. Continue foundational studies to performance.	ort center environments. Develop offectively anticipate and influence						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Conduct research to enhance human component influence, and dominate adversary's air, space, and cyber ISR systematic structure in the second structure in the second structure in the second structure in the second structure is the se		0.000	1.593	2.518	0.000	2.51	
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Conduct cognitive task analysis and cognitive system intelligence analyst tools, training, and methods to establish and control of air, space, and cyber ISR collection capabilities. Sp universal situational awareness, dynamic control of ISR planning source/multi-intelligence collaboration.	nd demonstrate dynamic command and ecific ISR capability objectives include						
FY 2011 Base Plans: In FY 2011: Conduct research to enable human operators to a systems in planning for dynamic situations. Conduct research dynamic planning capabilities for intelligence analysts.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: Human Effectiveness Research	0602202F: Human Effectiveness Applied 625328: H				n
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Conduct research to develop technology base f environment using past and present battlefield mission states to pr		0.000	2.241	1.368	0.000	1.368
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Refine knowledge of representation techniques to and complex systems of systems and begin integrating inform integrated set of work aids to achieve persistent operational p focused execution. Develop aids to enhance understanding o	ation within visual displays. Research lanning, persistent prediction, and					
FY 2011 Base Plans: In FY 2011: Research ability of models to simulate enemy po complex adversarial behavior. Explore the feasibility to integr						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Conduct research in adversarial modeling, cross speech translation tools for AF missions.	s-cultural communication, and automated	0.000	6.111	6.683	0.000	6.68
FY 2009 Accomplishments: In FY 2009: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: Human Effectiveness Research	PE 0602202F: Human Effectiveness Applied				on
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans: In FY 2010: Conduct research to develop behavioral modelin threats. Develop measures of effectiveness for selected influe speech-to-speech translation tools that support automated, cr</li> <li>FY 2011 Base Plans: In FY 2011: Develop adversarial cultural modeling techniques advanced models/simulation to demonstrate measures of effectiveness of effectiveness capabilities. Research foreign language speech-to-support automated, cross-cultural communications.</li> </ul>	ence operations capabilities. Develop oss-cultural communications. s to gauge adversarial threats. Develop ectiveness for selected influence					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop models/metrics to predict/evaluate org collaboration readiness.	anizational effectiveness alignment and	0.000	1.108	1.079	0.000	1.079
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Identify organizational vulnerabilities at the struct or human operator levels. Focus on exploitation of theories in interpersonal relationships to provide an understanding of how degree of detection/suspicion among operators. Develop rele solutions, and simulation models to facilitate organizational ef	volving human trust in automation and v to influence systems with little to no evant organizational metrics, work design					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	PE 0602202F: Human Effectiveness Applied 625328: Hu				on
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Develop foundational decision aid concepts to expl and trust in automation for influence operators. Mature research support organizational change in government domains. Develo show the impact of improved work design, engaged organization readiness.	h on organizational effectiveness to p advanced models/simulations to					
FY 2011 OCO Plans: In FY 2011 OCO: N/A						
MAJOR THRUST: Conduct applied research in the areas of mather exploit/counter adversarial capabilities.	natics and electromagnetic theory to	0.000	1.046	0.968	0.000	0.968
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Conduct research on datasets from past/current in anticipatory research designed to enhance blue force situationa intent.						
FY 2011 Base Plans: In FY 2011: Refine advanced, automated algorithms for measu supporting improved influence operations capabilities. Develop situational awareness of adversarial location and intent.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
Accom	plishments/Planned Programs Subtotals	0.000	18.203	16.587	0.000	16.587

Exhibit R-2A, RDT&E Project Ju	istification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 2: Applied Research		, Air Force		<b>R-1 ITEM NO</b> PE 0602202 <i>Research</i>			Applied	<b>PROJECT</b> 625328: Human Dynamics Evaluation			on
C. Other Program Funding Sum	imary (\$ in Milli	ons <u>)</u>									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	FY 2009	<u>FY 2010</u>	<b>Base</b>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost
• PE 0603456F: <i>Human</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Effectiveness Adv Tech Dev.											
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, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
APPROPRIATION/BUDGET ACTIN 3600: Research, Development, Tes BA 2: Applied Research	Pesearch, Development, Test & Evaluation, Air Force PE 0602202F: Human Effectiveness Applied 625329:					PE 0602202F: Human Effectiveness Applied 625329: Sensory Evaluation a				ation and De	ecision
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	21.910	22.492	0.000	22.492	24.166	24.345	24.555	25.317	Continuing	Continuing

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develops warfighter interface technologies to enhance human-human and human- machine collaboration and system interaction in distributed decision-making environments.	0.000	4.996	4.881	0.000	4.881
FY 2009 Accomplishments: In FY 2009: Not Applicable.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	s Applied	PROJECT 625329: Se Science	329: Sensory Evaluation and Dec		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans: In FY 2010: Investigate individual and teams-of-teams performant in a cross-domain distributed environment to include air, space, a sensory technologies for operator functional state model develop adaptive interface algorithms for individual operator decision aidint</li> <li>FY 2011 Base Plans: In FY 2011: Investigate teams-of-teams performance metrics and teams-of-teams cognitive workload so that future development of team situational awareness in a network-centric environment. Inv cognitive workload independent of the workload of individual oper interface algorithms for operator decision aiding.</li> <li>FY 2011 OCO Plans:</li> </ul>	nd cyber. Explore alternate human ment. Begin initial understanding of ng. d begin to explore the nature of adaptive aiding algorithms shape vestigate algorithms that assess team					
In FY 2011 OCO: N/A MAJOR THRUST: Researches new control/display concepts and tech	nologies (e.g. information portraval	0.000	5.720	6.075	0.000	6.075
control devices, and decision aiding algorithms). Identify best design t		0.000	0.720	0.010	0.000	0.070
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Design and evaluate advanced visualization concep assessment associated with switching tasks, interruptions, and un multi-UAS control scenarios. Evaluate novel video exploitation ai monitor multiple video feeds. Compress critical net-centric and s UAS interfaces in a manner that permits flexible, high-level taskin	nexpected state changes within ds to enable a single operator to ystem information onto man-portable					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness A</i> <i>Research</i>	Applied	PROJECT 625329: Se Science	T Sensory Evaluation and Decision		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
techniques that improve operator awareness of UAS automati decisions.	ion mode and rationale for autonomous					
In FY 2011: Evaluate the utility of 3-D information displays, m reality technologies for multi-UAS supervisory control. General and coordinate with complex, intelligent UAS automation algo displays, including temporal displays that furnish proactive de in multi-UAS scenarios. Investigate unique facets of automati improve the overall UAS human-system bandwidth. FY 2011 OCO Plans:	ate intuitive ways to monitor, interact, prithms. Identify predictive information cision support to the human operator					
In FY 2011 OCO: N/A MAJOR THRUST: Battlespace visualization advances science an		0.000	5.877	6.162	0.000	6.16
optimizing, displaying, and assimilating sensory information to enh FY 2009 Accomplishments: In FY 2009: Not Applicable.	nance warfighter decision-making.					
FY 2010 Plans: In FY 2010: Explore vision enhancement techniques to increa for objects of interest in air, space, and cyber. Develop visual techniques for presenting complex information to enhance air Investigate presentation and interface technologies for enhance	lization technologies and interaction , space, and cyber operations.					
FY 2011 Base Plans: In FY 2011: Explore vision enhancement techniques that can analyst's ability to quickly categorize objects of interest. Perfo						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	Applied	PROJECT 625329: Se Science	Sensory Evaluation and Decision		
B. Accomplishments/Planned Program (\$ in Millions)			•			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
visualizations that support human knowledge when presented with space, and cyber domains. Develop visualizations and interaction information. Develop situational awareness presentation and inte warfighter knowledge. FY 2011 OCO Plans:	n techniques to exploit dynamic					
In FY 2011 OCO: N/A						
MAJOR THRUST: Conducts battlespace acoustics research on 3-D au technologies that mitigate effects of noise and enhances performance		0.000	4.520	5.374	0.000	5.374
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Examine applications of how advanced multimodal in team performance in large-scale communication networks. Conduct technologies for achieving shared situational awareness and explanarays of sensors in complex operational environments. Explore t and other advanced auditory cueing techniques for continuously n UAS technologies. Conduct research on sensor systems and imm facilitating remote telepresence and optimizing the presentation of machine interfaces.</li> </ul>	uct research on network-based audio oiting information from multi-layered he use of persistent audio displays nonitoring the status of complex nersive display technologies for					
FY 2011 Base Plans: In FY 2011: Evaluate the use of multimodal speech displays to op in large-scale communication networks. Conduct research on imr interfaces for exploiting large-scale networks of distributed informa situational awareness and time-critical decision effectiveness. Ex	nersive audio and multimodal ation and enhancing real-time					

Exhibit R-2A, RDT&E Project Ju	stification: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 2: Applied Research		, Air Force		<b>R-1 ITEM NO</b> PE 0602202 <i>Research</i>	-	-	Applied	lied 625329: Sensory Evaluation Science			cision
B. Accomplishments/Planned P	ogram (\$ in M	illions)									
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
display concepts to optimize to intuitive displays can promote											
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A											
			Accomplish	ments/Plann	ed Program	s Subtotals	0.000	21.113	22.492	0.000	22.492
							FY 2009	FY 2010			
Congressional Add: Advanced Ni	ght Vision Syst	em - Cockpi	t Integration				0.000	0.797	-		
FY 2009 Accomplishments: In FY 2009: Not Applicable.											
<i>FY 2010 Plans:</i> In FY 2010: Concuct Congre Integration.	ssionaly-directe	ed effort for a	Advanced N	ight Vision S	ystem - Coc	kpit					
				Congre	essional Add	s Subtotals	0.000	0.797			
C. Other Program Funding Sum	nary (\$ in Milli	ions)									
Line Item • PE 0603456F: <i>Human</i> <i>Effectiveness Adv Tech Dev.</i>	<u>FY 2009</u> 0.000	<b>FY 2010</b> 0.000	FY 2011 Base 0.000	FY 2011 OCO 0.000	<u>FY 2011</u> <u>Total</u> 0.000	FY 2012 0.000	<b>FY 2013</b> 0.000	FY 2014 0.000	FY 2015 0.000	Cost To Complete 0.000	<u>Total Cos</u> 0.000
<b>D. Acquisition Strategy</b> Not Applicable.											

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY	<b>R-1 ITEM NOMENCLATURE</b>	PROJECT	ensory Evaluation and Decision
3600: Research, Development, Test & Evaluation, Air Force	PE 0602202F: Human Effectiveness Applied	625329: Se	
BA 2: Applied Research	Research	Science	

#### **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, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
APPROPRIATION/BUDGET ACTIN 3600: Research, Development, Tes BA 2: Applied Research								Extreme			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
627184: Performance Evaluation in Extreme Environments	54.937	18.486	18.436	0.000	18.436	17.765	17.715	16.318	16.623	Continuing	Continuing

#### <u>Note</u>

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 biotechnology 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop interface technologies that enhance human-human and human-machine collaboration in network-centric warfare environments.	4.896	0.000	0.000	0.000	0.000
<i>FY 2009 Accomplishments:</i> In FY 2009: Explored the use of transparent multilingual collaboration tools for distributed multi- entity teaming. Developed multinational speech translation technologies for obscure languages. Determined the effects of collaboration technologies on performance efficiency, shared situational awareness, workload and decision making for tactical command and control. Began development of adaptive automated human-machine interfaces to improve real-time human-machine task sharing. Developed predictive operator state models and assessment tools for dynamic workflow and workload					

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Air Force <b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectivenes</i> <i>Research</i>	s Applied	PROJECT 627184: Pe Environmer		formance Evaluation in Extreme		
B. Accomplishments/Planned Program (\$ in Millions)	Research		Environmen	115			
<u>D. Accomplishments/rialmed riogram (p.m.minons)</u>		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
management. NOTE: In FY 2010, efforts from this major thru 5329 to better align efforts.	ust will move to Project 5328 and Project						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop cognitive system interface technological echelons of operations and to improve decision-making and pre-		4.296	0.000	0.000	0.000	0.00	
FY 2009 Accomplishments: In FY 2009: Expanded contents of DoD software design patter in graphical user interface building tools. Demonstrated colla centric environment. Investigated how collaboration technique synchronization. Researched the cultural and ethnic bases of human performance models that reflect cultural differences to NOTE: In FY 2010, efforts from this major thrust will move to	boration techniques in a distributed net- es can enable distributed team self- f human decision making and developed enable effects-based operations.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	s Applied	PROJECT 627184: Pe Environmer		ormance Evaluation in Extrem		
B. Accomplishments/Planned Program (\$ in Millions)			-				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 OCO Plans: In FY 2011 OCO: N/A							
MAJOR THRUST: Establish technology base for decision support past, present, and future battlefield missions and to predict the interview.		2.192	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Analyzed the results of the initial demonstration of technologies. Completed the transition of advanced uncertain center display. Transitioned methods needed to simulate energy more complex adversary behavior. Incorporated more extraport displays. Refined the knowledge representation techniques to complex systems of systems and began integrating into displa anticipatory planning and operations work aids to achieve pers prediction, and focused execution and evaluated the effect. C integration of the developed displays and technologies. NOT thrust will move to Project 5328 and Project 5329 to better alig FY 2010 Plans:	ty visualization techniques for command emy potential courses of action, including plated "sensemaking" results into o model potential adversaries and ays. Transitioned the integrated set of sistent operational planning, persistent conducted follow-on demonstration of the E: In FY 2010, efforts from this major						
In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop system control interface concepts enal capabilities. Identify best mix of methods/traditional design to direct		4.423	0.000	0.000	0.000	0.000	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	s Applied	PROJECT 627184: Pe Environme	Performance Evaluation in Extre		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Integrated real-time assessment tools into secon workstations to optimize operator task loading and avoid char generation operator workstations during field testing and flight highly autonomous UAVs. Began software design and develous software architectures of control-display concepts that allow n autonomous UAVs in urban environments and/or in large-sca In FY 2010, this major thrust will move to 5329 to better align</li> <li>FY 2010 Plans:</li> <li>In FY 2010: Not Applicable.</li> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Not Applicable.</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2011 OCO Plans:</li> <li>In FY 2011 OCO Plans:</li> <li>In FY 2011 OCO Plans:</li> </ul>	nelized attention. Used second t demonstration to control multiple, opment of common interface and ninimal numbers of operators to control le, strategic military operations. NOTE:					
<ul> <li>MAJOR THRUST: Develop/evaluate algorithms to enhance visual sensors, digital image processing, and solid-state display technolo</li> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Performed multispectral, real-time field evaluatio have been optimized for different tactical scenarios. Refined techniques to enhance decision-making by testing more intuit Tested these methods against current state-of-the-art to prove Began to develop visualization technologies that enhance cyb centers. NOTE: In FY 2010, this major thrust will move to 53</li> </ul>	ogies to enhance real-time imaging. ns of display algorithm sets that information portrayal and interaction ive visualizations and user interfaces. e and improve total system effectiveness. perspace understanding in command	4.515	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	Applied	PROJECT 627184: Pe Environme	valuation in	ation in Extreme	
B. Accomplishments/Planned Program (\$ in Millions)	,		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
FY 2011 Base Plans: In FY 2011: Not Applicable.						
FY 2011 OCO Plans: In FY 2011 OCO: N/A						
MAJOR THRUST: Develop advanced audio display technologies f including 3-D audio and active noise reduction to enhance perform		3.749	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Developed acoustic aiding for urban operations to communications by using ultrasonic and laser technology adv information gathering. Explored methods and developed mod under dynamic conditions for improved offensive operations. technologies for remote collaboration by exploiting advances Explored the individual and group processes that lead to com- auditory sensing technology to create virtual auditory reality for emphasizing its application to security forces. NOTE: In FY 2 to better align efforts.	ances to improve security forces' lels to predict acoustic detectability Developed auditory information-aiding n communication theory for individuals. munication breakdown. Improved or human interface to remote sensing,					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			7	DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	s Applied	PROJECT 627184: Pe Environme	valuation in	lation in Extreme			
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A								
MAJOR THRUST: Develop human-centered Information/Cyber Op quicker/more intuitive access to information, enhanced decision-m		11.672	0.000	0.000	0.000	0.000		
FY 2009 Accomplishments: In FY 2009: Developed and validated advanced IO/Influence techniques to enable increased offensive and defensive comb adversarial threats. Validated and completed IO/Influence Op capabilities. Developed and validated prototype of advanced Developed capability to anticipate adversarial behavior, both in the psychological operations domain. Investigated method concealed information. Developed collaborative tools and tra emphasis on distributed operations. NOTE: In FY 2010, this align efforts.	bat capabilities which counter asymmetric berations models and simulation speech-to-speech translation tool. individually and in group, with application s to enhance human ability to uncover ining for ISR team applications with							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.								
FY 2011 Base Plans: In FY 2011: Not Applicable.								
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A								
MAJOR THRUST: Develop databases from air/space sensors of h			4.484	4.873				

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	s Applied	<b>PROJECT</b> 627184: Performance Evaluatio Environments			on in Extreme	
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Optimized equipment technologies, refined proce to address the most common AF job-related injuries and disab to not only prevent injuries but also to optimize human perform design criteria to maximize operator performance and minimize between equipment fit, workload, anthropometry, physical capabiomechanics collaborative information technologies to collect against threats in hostile environments.</li> <li>FY 2010 Plans:</li> <li>In FY 2010: Use principles of biomechanics to analyze behavior</li> </ul>	ilities. Extended these improvements ance. Developed workstation e fatigue, based on interrelationships ability, and cognitive capability. Used and analyze data to protect forces						
develop initial analysis techniques to identify behaviors that se information to develop physical behavior signatures. Integrate help identify a human threat.	eem out-of-context. Include cultural						
FY 2011 Base Plans: In FY 2011: Complete development and validate techniques to out-of-context. Use these techniques to collect and analyze m behaviors. Develop models that include cultural information to expressions.	otion data to study expressions and						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Quantify and model operator performance in stretechnologies to mitigate effects of stressors on cognitive function, s		1.044	2.722	3.055	0.000	3.05	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force	COPRIATION/BUDGET ACTIVITY       R-1 ITEM NOMENCLATURE         Research, Development, Test & Evaluation, Air Force       PE 0602202F: Human Effectiveness Applied         Applied Research       Research         complishments/Planned Program (\$ in Millions)       FY 2009					
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	PE 0602202F: Human Effectivenes	s Applied	PROJECT 627184: Pe Environmer	Performance Evaluation in Extre		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Conducted behavioral neuroscience research to ch cognitive degradation during demanding military operations. Re performance monitoring technology and developed operational cognitive disruption technologies and potential countermeasures	efined real-time biobehavioral employment concepts. Investigated					
FY 2010 Plans: In FY 2010: Use performance databases to refine warfighter ph goal of improving retention and operational performance. Cond psychology and metabolomic research to enhance human perfor environments. NOTE: In FY 2010, this effort merges with majo align efforts.	uct research integrating behavioral prmance in multiple stressor					
FY 2011 Base Plans: In FY 2011: Use anthropometry data to develop techniques to i performance. Begin development of models to optimize warfigh performance.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
<ul> <li>MAJOR THRUST: Develop, demonstrate, and apply experimental n compromises and to assure protection of AF personnel from toxic has <i>FY 2009 Accomplishments:</i></li> <li>In FY 2009: Developed procedures and computer simulation m compound and nanomaterial exposure on Joint Service and Air computer modeling and systems biology approaches to understand</li> </ul>	azards and exposures. odels to predict effects of toxic Expeditionary Forces. Using	1.901	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	s Applied	PROJECT 627184: Pe Environme	valuation in	Extreme	
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
engineering, explored and created integrated new sensor and NOTE: In FY 2010, this effort is combined with the next major						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
FY 2011 OCO Plans: In FY 2011 OCO: N/A						
MAJOR THRUST: Conduct bio/nanotechnology research to advantoxicological/biological data to improve human performance and de		3.758	4.793	5.201	0.000	5.201
FY 2009 Accomplishments: In FY 2009: Completed genomic, proteomic, and metabolite s and liver biomarkers of hazardous agent exposure in deployed tissue, lung, and brain biomarkers of degradation from hazardo	Airmen. Investigated connective					
FY 2010 Plans: In FY 2010: Conduct research to identify and validate biomark physiological changes that enhance human performance. Cor toxicity. Define cell-based pathway engineering for biosensors	nduct analysis of novel AF nanomaterial					
FY 2011 Base Plans: In FY 2011: Conduct research to identify and validate biomark physiological changes that enhance cognition and optimize pe in nanomaterial toxicity. Demonstrate cell-based pathways for	rformance in training. Complete studies					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	Applied	PROJECT 627184: Pe Environmer		e Evaluation in Extreme		
B. Accomplishments/Planned Program (\$ in Millions)	· · · · ·		1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 OCO Plans: In FY 2011 OCO: N/A							
MAJOR THRUST: Develop logistics readiness technology options large-scale advanced technology development programs.	and perform feasibility studies to support	1.305	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Explored and applied integrated, multifunction jol controlled field tests. Investigated the usefulness of collabora complex field repair problems. Explored the hardware, softwa job aid and on-the-job training devices for maintenance work. terminated due to higher AF priorities.	tion support for troubleshooting and are, and packaging issues for combined						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
FY 2011 OCO Plans: In FY 2011 OCO: N/A							
MAJOR THRUST: Conduct counterproliferation research to support and assessment of threat agents and provide information for air operation for a statement of threat agents and provide information for air operation for a statement of threat agents and provide information for a statement of threat agents and provide information for a statement of threat agents and provide information for a statement of threat agents agents and provide information for a statement of threat agents agents and provide information for a statement of threat agents and provide information for a statement of threat agents and provide information for a statement of threat agents and provide information for a statement of threat agents and provide information for a statement of threat agents and provide information for a statement of threat agents and provide information for a statement of threat agents and provide information for a statement of threat agents and provide information for a statement of threat agents and provide information for a statement of threat agents and provide information for a statement of threat agents and provide information for a statement of the statement of threat agents and provide information for a statement of the statement of the statement of threat agents and provide information for a statement of the statement of threat agents and provide information for a statement of the statement of		0.000	4.894	5.307	0.000	5.307	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: Human Effectiveness Research	Applied	PROJECT 627184: Pe Environmen	valuation in	Extreme	
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans: In FY 2010: Conduct research to develop nanoparticle taggar of preemptive airstrike destruction of biological warfare agents to effectively neutralize genetically-modified biological threat a anticipate impacts of high threat environments on air operation awareness. NOTE: In FY 2010, this major thrust will move from FY 2011 Base Plans: In FY 2011: Expand and refine nanoparticle taggants for line- preemptive destruction of biological warfare agents. Develop modified biological threat agents. Develop technologies to an operations and to provide post-attack situational awareness.</li> </ul>	s. Define preliminary techniques agents. Perform initial research to hs and to provide post-attack situational om Project 7757 to better align efforts. of-sight, standoff assessment of technologies to neutralize genetically					
FY 2011 OCO Plans: In FY 2011 OCO: N/A						
Acco	mplishments/Planned Programs Subtotals	48.354	16.893	18.436	0.000	18.43
				1		
		FY 2009	FY 2010	_		
Congressional Add: Imaging Tools for Human Performance Enhant FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Im		1.995	1.593			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness A</i> <i>Research</i>	Applied	PROJECT 627184: Pe Environme	erformance Evaluation in Extrem nts
3. Accomplishments/Planned Program (\$ in Millions)				
		FY 2009	FY 2010	
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Imag Enhancement and Diagnostics.	ing Tools for Human Performance			
		2.992	0.000	
Congressional Add: Homeland Emergency Learning and Prepare	dness (HELP) Center.			
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for HE	ELP Center.			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Smart View Program (SVP).		0.798	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for SV	/P.			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
		0.798	0.000	-
Congressional Add: Tools and Technologies for Incident and Con	sequence Management.			
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for To Consequence Management.	ols and Technologies for Incident and			
FY 2010 Plans: In FY 2010: Not Applicable.				

Exhibit R-2A, RDT&E Project Justi	ification: PB	2011 Air Fo	rce						DATE: Feb	uary 2010			
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 2: Applied Research		, Air Force		<b>R-1 ITEM NO</b> PE 0602202 <i>Research</i>	-	-	Applied	pplied <b>PROJECT</b> 627184: Performance Evaluation in E Environments					
<b>B. Accomplishments/Planned Prop</b>	gram (\$ in M	<u>illions)</u>											
							FY 2009	FY 2010					
				Congre	ssional Add	s Subtotals	6.583	1.593					
C. Other Program Funding Summa	arv (\$ in Mill	ions)						<u>.</u>					
		10113]	FY 2011	FY 2011	FY 2011					Cost To			
Line Item	FY 2009	<u>FY 2010</u>	Base	000	Total	FY 2012	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	Complete	Total Cost		
• PE 0602201F: Aerospace Flight	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Dynamics.													
• PE 0602204F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Sensors.													
• PE 0602702F: Command,	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Control, and Communications.	0.000	0.000	0.000	0.000	0.000	0 000	0.000	0.000	0.000	0.000	0.000		
• PE 0603205F: Flight Vehicle	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Technology. • PE 0603231F: Crew Systems	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
and Personnel Protection	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Technology.													
• PE 0603245F: Flight Vehicle	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Technology Integration.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
• PE 0603456F: Human	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Effectiveness Adv Tech Dev.													
• PE 0604706F: Life Support	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Systems.													

#### 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-2A, RDT&E Project Jus	tification: PE	3 2011 Air F	orce						DATE: February 2010			
APPROPRIATION/BUDGET ACTI 3600: Research, Development, Tes BA 2: Applied Research		n, Air Force										
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
627757: Directed Energy Bioeffects	18.826	15.075	16.723	0.000	16.723	17.629	17.550	18.157	18.597	Continuing	Continuing	

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Conducts laboratory experiments and field research on laser bioeffects, enabling military exploitation of laser technology while providing countermeasures for optical hazards/threats.	6.606	7.497	8.186	0.000	8.186
FY 2009 Accomplishments: In FY 2009: Performed 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. Integrated collateral hazard assessment software model into airborne laser platform performing high energy laser system demonstrations. Initiated experiments for future high energy laser weapon systems to predict, evaluate, and explore target bioeffects.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	s Applied	<b>PROJECT</b> 627757: <i>Di</i>	T Directed Energy Bioeffects		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Evaluate collateral hazard assessment software r and develop next generation of hazard assessment tools. Fur database for multiple wavelengths to validate DoD, national, and Evaluate superthreshold tissue impacts and further define weat experiments for future high energy laser weapon systems to pr bioeffects.	ther expand laser damage threshold nd international safety standards. Ipon effectiveness parameters. Conduct					
FY 2011 Base Plans: In FY 2011: Conduct research to refine DoD, national, and interto include multiple wavelength laser exposures. Initiate resear while operating in a high energy directed energy weapon haza assessment software for high energy laser systems and weapon	ch to provide personal protection rd zones. Validate collateral hazard					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Conducts laboratory experiments and field researched energy technologies for communication, target identification	•	6.481	7.185	8.136	0.000	8.13
FY 2009 Accomplishments: In FY 2009: Conducted experiments to refine and eliminate ga for microwave, ultra-wide band, high peak power RFR systems Integrated and improved human behavior, bioeffects, and targe RFR studies in microwave, ultra-wide band, high peak power, a RFR bioeffects as a foundation for future RFR weapons.	s, and terahertz frequency ranges. et effects computer models based on					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectivenes</i> <i>Research</i>	s Applied	<b>PROJECT</b> 627757: <i>Di</i>	y Bioeffects		
B. Accomplishments/Planned Program (\$ in Millions)	·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Evaluate biological responses to high power and cellular to whole organism perspectives. Validate models of R field experimentation, as well as applied mathematics. Condu- effectiveness of scalable directed energy weapon systems. Co safety of terahertz sources.	FR bioeffects through laboratory and ct research to support fielding and					
FY 2011 Base Plans: In FY 2011: Conduct terahertz research in order to refine national levels and evaluate potential military utility. Conduct bioeffects energy weapon capabilities. Initiate development of a model of experimentation and theoretical physics. Assess combinations behavior and physiology.	s research to support scalable directed of scalable RFR effects based on					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Concentrates on human responses to non-letha assess the effects and risk of these weapons.	I weapons and conducts research to	0.000	0.393	0.401	0.000	0.401
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Develop initial quantitative models of behavioral r Develop Human Effect-Modeling Applications Program (HE-M interface that links graphical user interfaces with predictive mo induced effectiveness and risk. Incorporate within HE-MAP th and effects-based module that will allow analysis of design par	AP) by incorporating a software dels of RFR non-lethal weapon- e development of a design optimization					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: Human Effectiveness , Research	Applied	<b>PROJECT</b> 627757: Directed Energy Bioeffects			
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>effectiveness. NOTE: In FY 2010, this effort is broken out from distinct technology areas.</li> <li><i>FY 2011 Base Plans:</i> In FY 2011: Develop initial quantitative models of behavioral redirected energy non-lethal weapons. Enhance HE-MAP throug linking HE-MAP graphical user interfaces with predictive model induced effectiveness and risk. Incorporate within HE-MAP through design module that will allow analysis of design parameters of their influence on effectiveness. </li> <li><i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A</li></ul>	esponses using effects data from gh addition of a software interface s of acoustic non-lethal weapon- e development of an effects-based					
<ul> <li>MAJOR THRUST: Develop biotechnologies to support detection, ragents. Perform counterproliferation research to enable operations</li> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Refined viability assessment technologies and de distribution patterns to minimize collateral damage from counter advanced biological taggant technologies that will locate biologiand in containers. Investigated counterproliferation technologies genetically modified biological threat agents. NOTE: In FY 2007 184 to better align efforts.</li> <li>FY 2010 Plans:</li> <li>In FY 2010: Not Applicable.</li> </ul>	in high threat environments. eveloped models that predict plume erforce weapon detonations. Developed gical warfare agents behind walls ies capable of effectively neutralizing	3.709	0.000	0.000	0.000	0.00

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602202F: <i>Human Effectiveness</i> <i>Research</i>	Applied	<b>PROJECT</b> 627757: <i>Di</i>	rected Energ	y Bioeffects	
B. Accomplishments/Planned Program (\$ in Millions)	'		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Not Applicable. FY 2011 OCO Plans:						
In FY 2011 OCO: N/A MAJOR THRUST: Develop technology solutions integrating beha nutritional strategies, and personal protective technologies to opti		2.030	0.000	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Developed and assessed benefit of tailored/agile regimens to confront asymmetric threats. Expanded biobeha individual differences in human performance vulnerability. Ne move to Project 7184 to better align efforts.	vioral performance models to incorporate					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
FY 2011 OCO Plans:						
In FY 2011 OCO: N/A					0.000	16.72

Exhibit R-2A, RDT&E Project Jus	stification: PB	2011 Air Fo	rce					_	DATE: February 2010		
APPROPRIATION/BUDGET ACTI 3600: Research, Development, Tes BA 2: Applied Research	ch, Development, Test & Evaluation, Air Force PE 0602202F: Human Effectiveness Applied 627757: Dire						rected Energ	y Bioeffects			
C. Other Program Funding Sumn	nary (\$ in Mill	ions)									
			FY 2011	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	<u>000</u>	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost
• PE 0602720A: Environmental	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Quality Technology.											
• PE 0603231F: Crew Systems	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
and Personnel Protection											
Technology.											
• PE 0603456F: <i>Human</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Effectiveness Adv Tech Dev.											
• PE 0604617F: Agile Combat	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Support.											
• PE 0604706F: Life Support	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Systems.											

#### **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, RDT&E Budget Item	Justification	: PB 2011 A	ir Force						DATE: February 2010		
<b>APPROPRIATION/BUDGET ACT</b> 3600: <i>Research, Development, Te</i> BA 2: <i>Applied Research</i>		n, Air Force			I <b>OMENCLA</b> 3F: <i>Aerospa</i>	<b>TURE</b> ce Propulsio					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	244.890	221.503	207.049	0.000	207.049	209.957	208.178	193.981	192.019	Continuing	Continuing
623012: Advanced Propulsion Technology	17.276	17.494	22.859	0.000	22.859	20.455	23.235	20.850	21.336	Continuing	Continuing
623048: Combustion and Mechanical Systems	27.086	19.638	18.679	0.000	18.679	20.087	18.995	16.640	15.778	Continuing	Continuing
623066: Turbine Engine Technology	85.675	60.655	67.274	0.000	67.274	69.169	65.198	55.689	52.170	Continuing	Continuing
623145: Aerospace Power Technology	48.865	41.254	32.604	0.000	32.604	32.781	33.037	31.897	32.657	Continuing	Continuing
6233SP: Space Rocket Component Tech	56.539	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
624847: Rocket Propulsion Technology	9.449	75.582	58.954	0.000	58.954	61.231	61.141	62.337	63.534	Continuing	Continuing
625330: Aerospace Fuel Technology	0.000	6.880	6.679	0.000	6.679	6.234	6.572	6.568	6.544	0.000	0.000

#### <u>Note</u>

Note: In FY 2010, funds from Project 33SP have been moved to Project 4847 within this program element and from Project 3048 to Project 5330 within this program element to better align efforts.

#### 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 project 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 Combustion and Mechnical Systems project evaluates 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

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 A	ir Force			DATE	: February 2010	)
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research		<b>-1 ITEM NOMEN</b> E 0602203F: <i>Ae</i>	ICLATURE rospace Propulsion	i		
systems to include efforts that are part of the VAATE progra optimized performance/fuel efficiency for widely varying mis technologies for military applications that are part of the Inte advances in rocket propulsion technologies for space access Fuel Technology project evaluates hydrocarbon-based fuels This program is in Budget Activity 2, Applied Research, sinc technologies.	ssion needs. T egrated Vehicl ss, space man s for legacy ar	he Aerospace Po e Energy Techno euver, missiles, t ad advanced turb	ower Technology project d blogy (INVENT) program. the sustainment of strateg ine engines, scramjets, pu	levelops electrical powe The Rocket Propulsion ic systems and tactical r Ilse detonation, and con	r and thermal n Fechnology pro rockets. The Ae nbined-cycle er	nanagement ject develops rospace ngines.
B. Program Change Summary (\$ in Millions)						
	<u>FY 200</u>			FY 2011 OCO	<u>FY 2011</u>	
Previous President's Budget	252.02			0.000		0.000
Current President's Budget	244.89			0.000		)7.049 )7.049
Total Adjustments <ul> <li>Congressional General Reductions</li> </ul>	-7.13	4 24.972 -5.000		0.000	20	07.049
Congressional Directed Reductions		-5.000				
Congressional Rescissions	0.00					
Congressional Adds	0.00	30.912				
Congressional Directed Transfers		0.000				
Reprogrammings	0.00					
SBIR/STTR Transfer	0.00					
Other Adjustments	-7.13	.000	207.049	0.000	20	07.049
Congressional Add Details (\$ in Millions, and Inclu	ides General	Reductions)			FY 2009	FY 2010
Project: 623048: Combustion and Mechanical Syster	ns					
Congressional Add: National Test Facility for Aero	ospace Fuels a	and Propulsion.			1.356	0.000
Congressional Add: Hybrid Bearings.					1.596	0.797
			Congressional Add Subto	tals for Project: 623048	2.952	0.797
Project: 623066: Turbine Engine Technology					<u> </u>	
Congressional Add: Split Discharge Variable Deliv	ery Pump for	Military Aircraft.			0.000	1.593

bit R-2, RDT&E Budget Item Justification: PB 2011 Air Ford	e [	DATE: February 2010	)
ROPRIATION/BUDGET ACTIVITY Research, Development, Test & Evaluation, Air Force Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>		
Congressional Add Details (\$ in Millions, and Includes G	Seneral Reductions)	FY 2009	FY 201
	Congressional Add Subtotals for Project: 62	3066 0.000	1
Project: 623145: Aerospace Power Technology			
Congressional Add: Advanced Fuel Cell Based Power S	System for Small UAVs.	1.197	0
Congressional Add: Affordable Lightweight Power Supp	ly Development.	0.997	C
Congressional Add: Electronics Liquid Cooling For Adva	anced Military Ground and Aerospace Vehicle Projects.	0.997	C
Congressional Add: Integrated Aircraft Energy Manager	ment.	1.995	C
Congressional Add: Integrated Power for Aircraft Techn	ologies (INPACT II).	3.491	C
Congressional Add: Lithium Ion Domestic Materials Dev	velopment.	1.596	(
Congressional Add: Advanced Lithium Battery Scale-Up	o and Manufacturing.	1.596	,
Congressional Add: Energy Superior Lithium Battery Te	chnology for Defense Applications.	5.983	1
Congressional Add: Integrated Engine Starter/Generate	r.	1.596	1
Congressional Add: Wavelength Agile Spectral Harmon	ic Oxygen Sensor and Cell-Level Battery Controller.	0.798	1
Congressional Add: High-Energy Li-lon Technology for	Aviation Batteries.	0.000	1
Congressional Add: Thermal and Energy Management	for Aerospace.	0.000	3
	Congressional Add Subtotals for Project: 62	3145 20.246	10
Project: 6233SP: Space Rocket Component Tech			
Congressional Add: Advanced Vehicle and Propulsion	Center.	1.197	(
Congressional Add: Hydrocarbon Boost Technology De	monstrator.	1.396	(
Congressional Add: Development and Testing of Advan	ced Paraffin Based Hybrid Rockets for Space Applications.	2.792	(
Congressional Add: Integrated Propulsion Analysis Too	I (IPAT).	1.995	(
Congressional Add: Multi-Mode Space Propulsion.		0.798	C

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	C	ATE: February 2010	)
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>		
Congressional Add Details (\$ in Millions, and Includes Ge	eneral Reductions)	FY 2009	FY 2010
Congressional Add: Vortex Low Cost Rocket Engine.		2.393	0.000
	Congressional Add Subtotals for Project: 623	3SP 10.571	0.000
Project: 624847: Rocket Propulsion Technology			
Congressional Add: Aerospace Lab Equipment Upgrade.		0.798	1.195
Congressional Add: Advanced Vehicle Propulsion Center	·	0.000	2.390
Congressional Add: AFRL Edwards Rocket Test Stand 2	-A Technical Improvements.	0.000	3.187
Congressional Add: Development and Testing of Advanc	ed Hybrid Rockets for Space Applications.	0.000	2.788
Congressional Add: Integrated Propulsion Analysis and S	Spacecraft Engineering Tools (IPAT/ISET).	0.000	4.780
Congressional Add: Multi-Mode Propulsion Phase IIA: Hi	gh Performance Green Propellant.	0.000	1.593
Congressional Add: Next Generation Solar Electric In-Sp	ace Propulsion.	0.000	0.797
	Congressional Add Subtotals for Project: 624	847 0.798	16.730
Project: 625330: Aerospace Fuel Technology			
Congressional Add: National Test Facility for Aerospace	Fuels Propulsion.	0.000	1.306
	Congressional Add Subtotals for Project: 625	330 0.000	1.306
	Congressional Add Totals for all Proj	ects 34.567	30.782

#### **Change Summary Explanation**

In FY 2009 and 2010, the 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. Starting in FY 2010, Funds from Project 33SP have been moved to Project 4847 within this Program Element to more accurately align efforts.

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	
BA 2: Applied Research		

In FY 2010, Congress added \$1.6 million for Advanced Lithium Battery Scale-up and Manufacturing, \$2.4 million for Advanced Vehicle Propulsion Center, \$1.2 million for Aerospace Lab Equipment Upgrade, \$3.2 million for AFRL Edwards Rocket Test Stand 2-A Technical Improvements, \$2.8 million for Development and Testing of Advanced Hybrid Rockets for Space Applications, \$1.6 million for Energy Superior Lithium Battery Technology for Defense Applications, \$1.2 million for High-Energy Li-Ion Technology for Aviation Batteries, \$0.8 million for Hybrid Bearings, \$1.6 million for Integrated Engine Starter/Generator, \$4.8 million for Integrated Propulsion Analysis and Spacecraft Engineering Tools (IPAT/ISET), \$1.6 million for Nulti-Mode Propulsion Phase IIA: High Performance Green Propellant, \$1.312 million for National Test Facility for Aerospace Fuels Propulsion, \$0.8 million for Next Generation Solar Electric In-Space Propulsion, \$1.6 million for Split Discharge Variable Delivery Pump for Military Aircraft, \$3.2 million for Thermal and Energy Management for Aerospace, and \$1.2 million for Wavelength Agile Spectral Harmonic Oxygen Sensor and Cell-Level Battery Controller.

C. Performance Metrics (U) Under Development.

Exhibit R-2A, RDT&E Project Ju	stification: PE	3 2011 Air F	orce						DATE: Feb	ruary 2010	
					<b>R-1 ITEM NOMENCLATUREP</b> PE 0602203F: Aerospace Propulsion6.				lvanced Pro <sub>l</sub>	nology	
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
623012: Advanced Propulsion Technology	17.276	17.494	22.859	0.000	22.859	20.455	23.235	20.850	21.336	Continuing	Continuing
<b>A. Mission Description and Bud</b> This project develops combined revolutionary propulsion options focus is on hydrocarbon-fueled e	advanced cycl for the Air For	e air breathi ce. These ne	ew engine te	chnologies v	vill enable fu	ture high-sp	eed/hyperso	nic weapons	s and aircraf	t concepts. T	• •

#### **B. Accomplishments/Planned Program (\$ in Millions)**

demonstrations of critical components; advanced component development; and ground-based demonstrations.

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop advanced fuel-cooled scramjet engine technologies to support flight demonstration and enable the broad application of hypersonics to meet future warfighter needs.	3.200	1.650	1.150	0.000	1.150
FY 2009 Accomplishments: In FY 2009: 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. Conducted design of ground test hardware of advanced scramjet start techniques. Completed development of scramjet engine control logic for flight test engines. 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.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsio</i>	n	<b>PROJECT</b> 623012: Ad	lvanced Prop	oulsion Techi	nology
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Develop and demonstrate flight weight engine co logic. Perform trajectory optimization for flight test. Complete g technique. Fabricate flight test hardware to demonstrate ramje FY 2011 Base Plans:	ground test of advanced scramjet start					
In FY 2011 Base Plans: In FY 2011: Develop and demonstrate flight weight engine co logic. Perform trajectory optimization for flight test. Participate ramjet to scramjet transition.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Conduct assessments, technology design trade cycle engines (CCEs) and air breathing hypersonic propulsion tech		0.165	0.165	0.165	0.000	0.16
FY 2009 Accomplishments: In FY 2009: Continued trade studies to determine military pay goals. Continued defining component and engine performance of affordable hypersonic flight demonstrators jointly with NASA components for turbine-based and rocket-based CCEs.	e objectives to enable development					
FY 2010 Plans: In FY 2010: Conduct trade studies to determine military payor goals. Define component and engine performance objectives hypersonic flight demonstrators jointly with NASA and DARPA advanced components for turbine-based and rocket-based CO	to enable development of affordable A. Develop technology maturation plan for					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsic</i>				<b>PROJECT</b> 623012: Advanced Propulsion Technolog			
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
FY 2011 Base Plans: In FY 2011: Conduct trade studies to determine military payof goals. Define component and engine performance objectives t hypersonic flight demonstrators jointly with NASA and DARPA including test facility requirements, for advanced components CCEs.	o enable development of affordable . Develop technology maturation plan,							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.								
MAJOR THRUST: Develop robust hydrocarbon fueled scramjet er improve performance, operability, durability, and scalability for futu		13.911	15.679	21.544	0.000	21.54		
FY 2009 Accomplishments: In FY 2009: Continued development of advanced engine com margin and to establish scramjet scaling laws for reusable app variable geometry techniques to decrease scramjet take-over robust options for CCEs. Continued development of low intern flight test engine components. Conducted assessment of grou demonstrate large (20 to 100 times) size scramjet engines.	lications. Continued development of from Mach 4.5 to Mach 3.5 to provide al drag flame stabilization devices and							
FY 2010 Plans: In FY 2010: Develop advanced engine components to improv refine scramjet scaling laws for reusable applications. Develop over from Mach 4.5 to Mach 3.5 to provide robust options for 0 stabilization devices and flight test engine components. Fabric represent medium scale (5 to 20 times) scramjet engines.	techniques to decrease scramjet take- CCEs. Develop low internal drag flame							

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fc	orce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIV</b> 3600: Research, Development, Test BA 2: Applied Research		, Air Force		<b>R-1 ITEM N</b> PE 0602203	-	-	ז	<b>PROJECT</b> 623012: <i>Ad</i>	vanced Prop	oulsion Tech	nology
B. Accomplishments/Planned Prog	gram (\$ in M	illions)	1					1			
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Develop advanced refine scramjet scaling laws for over from Mach 4.5 to Mach 3.5 stabilization devices and flight to represent medium scale (5 to FY 2011 OCO Plans: In FY 2011 OCO: N/A.</li> </ul>	reusable app to provide re est engine co	blications. De bust option omponents.	evelop techn is for CCEs. Ground test nes.	iques to dec Develop low	rease scram internal dra nponents/cc	ijet take- g flame ombustors	17.276	17.494	22.859	0.000	22.859
			Accomplish	ments/Plann	ed Program	s Subtotais	17.276	17.494	22.859	0.000	22.85
C. Other Program Funding Summa	ary (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	FY 2011					Cost To	
Line Item	FY 2009	FY 2010	Base	000	<u>Total</u>	FY 2012	FY 2013	FY 2014	FY 2015	Complete	
• PE 0601102F: <i>Defense</i> <i>Research Sciences</i> .	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0602201F: Aerospace Flight Dynamics.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0602500F: <i>Multi-Disciplinary</i> <i>Space Tech.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0602602F: Conventional Munitions.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0602702E: Tactical Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0603211F: Aerospace Structures.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force							DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>				<b>PROJECT</b> 623012: Advanced Propulsion Technology			
C. Other Program Funding Summa											
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					Cost To	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost
• PE 0603216F: Aerospace											
Propulsion and Power Technology.											
• PE 0603601F: Conventional	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Weapons Technology.			0 000				0 000				0.000
• PE Not Provided (5580):	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Program is reported to/coordinated											
by the Joint Army/Navy/NASA/											
Air Force (JANNAF) Executive											
Committe											
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, RDT&E Project Justification: PB 2011 Air Force							DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research			<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>				<b>PROJECT</b> 623048: Combustion and Mechanical Systems				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
623048: Combustion and Mechanical Systems	27.086	19.638	18.679	0.000	18.679	20.087	18.995	16.640	15.778	Continuing	Continuing

#### <u>Note</u>

Note: In FY 2010, the fuels portion of this Project was moved to PE 0602203F Project 5330 within this Program Element 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.

#### B. Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop low-cost additive and fuel system approaches to improve fuel properties. Determine fuel cooling requirements and specifications for adaptive cycle engine architecture.	3.000	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Conducted lab-scale evaluation of approaches to increase JP-8 temperature capability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced alternative energy fuels, and improved materials and coatings. Continued efforts to validate component performance models on aircraft thermal management simulator. Tested fuel candidates in bench scale					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsio</i>	n	<b>PROJECT</b> 623048: Co	ombustion and Mechanical Syste		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
rigs simulating advanced high Mach propulsion systems and ultra efficient turbine engine components. Conducted full-scale component rig testing of mechanical components with prototype lubricants. Conducted simulated high-Mach tests of an integrated thermal management system and mechanical system components.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop advanced additive approaches to reduct (including nano-scale additives), as well as advanced emission diag		1.000	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Continued higher-pressure measurements of addit particulate generation during combustion. Initiated study of NO Improved combustion models for kerosene fuels.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	n	<b>PROJECT</b> 623048: Co	PROJECT 623048: Combustion and Mechanica		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Study and evaluate low-cost approaches to red Study fuel logistics vulnerabilities and develop detection and mitigation and mitigation and study fuel study fuel logistics vulnerabilities and develop detection and mitigation and study fuel logistics vulnerabilities and		1.000	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Expanded investigation of performance of biomas field hardware. Extended knowledge base to other alternative biomass. Developed bioreactors to simulate biological growth storage facilities. Expanded knowledge base for certification of vehicles.	fuels, such as those derived from in aircraft fuel systems and ground					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Investigate hydrocarbon and other high energy cycle engines for high-speed aerospace vehicles and low-cost boo		0.500	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Expanded study of high-energy hydrocarbon prop physical property database for kerosene propellants at high pr property for high energy hydrocarbons and improved physical	essure. Collected improved physical					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>		<b>PROJECT</b> 623048: <i>Cc</i>	T Combustion and Mechanical System		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop, test, and evaluate revolutionary combust turbine, pulsed detonation, and combined cycle engines for missiles, r		7.061	7.100	8.128	0.000	8.128
FY 2009 Accomplishments: In FY 2009: Evaluated advanced combustion system performance Demonstrated small-scale inter-turbine burning concepts in small of inter-turbine burning concepts for large gas turbine engines. Of of the integrated pulsed detonation/hybrid turbine. Evaluated and augmentor, and pulse detonation engine concepts using modeling flight conditions and applications.	engines. Identified concept designs otimized component efficiency optimized advanced combustor,					
FY 2010 Plans: In FY 2010: Test concept designs for larger-scale inter-turbine bu conditions. Evaluate performance characteristics in small internal fuels. Identify potential performance improvements for small engine augmentor, continuous detonation, and pulse-detonation concept system performance. Study combustion processes using alternat models for combustion processes. Employ modeling and simulat combustion systems. Investigate high-efficiency direct injection m	combustion engines burning military nes. Investigate novel combustor, s that reduce fuel burn and improve ve fuels. Develop new chemistry ion tools to evaluate advanced					
FY 2011 Base Plans: In FY 2011: Test full-scale inter-turbine burner concepts at releva novel valving concepts for pulse detonation engines. Study pulse						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	n	<b>PROJECT</b> 623048: <i>Co</i>	mbustion an	nd Mechanical Systems	
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
interactions. Explore the use of regenerative fuel cooling with puc combustion systems. Demonstrate novel small internal combust system performance. Use advanced modeling and simulation to processes and to guide combustion system design. Employ new fuels. Test concept designs for adaptive combustors for ultra eff which reduce harmful emissions.	ion engine concepts that improve ols to understand combustion w chemistry models for alternative					
FY 2011 OCO Plans: In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop approaches to extend the life of endother for sustained supersonic and reusable hypersonic cruise applications		0.500	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Conducted bench-scale tests to evaluate improved endothermic fuels. Assessed unconventional approaches to incr regenerative cooling heat loads. Studied relationship between fu behavior including blowout.	ease fuel heat sink and minimize					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
FY 2011 OCO Plans: FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate optical, electromechar sensors for application to revolutionary propulsion technologies.	ical, and laser diagnostic tools and	1.000	1.000	1.212	0.000	1.212

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsio</i>	n	<b>PROJECT</b> 623048: <i>Co</i>	JECT 48: Combustion and Mechanical System				
B. Accomplishments/Planned Program (\$ in Millions)	I							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>FY 2009 Accomplishments: In FY 2009: Developed high-speed techniques for measuring of oxidiation/combustion efficiency in near constant volume combutultrafast (e.g., femtosecond), ultraintense (e.g., terawatt) lasers bursts for soot-mitigation studies and dense-fuel-spray imaging ballistic imaging to understand and improve fuel sprays in combutapplications. Developed ultrafast (picosecond, femtosecond) complications. Developed ultrafast (picosecond, femtosecond) complication diagnostics suites to characterization and improvement of FY 2010 Plans: In FY 2010 Plans:</li> <li>In FY 2010: Develop MHz-rate high-speed measurement technic two-color planar laser-induced fluorescence techniques to measurement species and apply to relevant combustion devices. Apply ultrafast 2009 to practical combustion devices and engine systems. Apply to characterize and improve engine combustors and afterburne</li> <li>FY 2011 Base Plans: In FY 2011: Use two-color planar laser induced fluorescence techniques to measurement combustion systems. Develop robust line-of-sight measurement species and apply to relevant combustion devices. Apply ultrafast 2009 to practical combustion devices and engine systems. Apply to characterize and improve engine combustors and afterburne</li> <li>FY 2011 Base Plans: In FY 2011: Use two-color planar laser induced fluorescence techniques to relevant-environment combustion systems. Develop robust line for temperature and species and apply to relevant apply to relevant apply to relevant planar laser induced fluorescence techniques for temperature and species and apply to relevant planar laser induced fluorescence techniques for temperature and species and apply to relevant planar laser induced fluorescence techniques for temperature and species and apply to engine systems. Develop robust line for temperature and species and apply to engine systems. Develop robust line for temperature and species and apply to engine systems. Develop robust line for temperature and species and apply to engine systems</li></ul>	ustion turbine environments. Exploited systems to generate ultrashort x-ray . Developed multi-pulse femtosecond oustor, augmentor, scramjet, and rocket oherent anti-Stokes Raman scattering bustion devices. Applied advanced of engine combustors and afterburners. hiques for combustion species. Use sure temperature in experimental t techniques for temperature and ast CARS techniques developed in FY ly advanced optical diagnostics suites rs. echniques to measure temperature ne-of-sight measurement techniques elop simultaneous high-speed planar neasurements of species and velocity							
in relevant-environment combustion systems. Develop robust li for temperature and species and apply to engine systems. Deve	ne-of-sight measurement techniques elop simultaneous high-speed planar neasurements of species and velocity asurement techniques for temperature mographic reconstruction of complex advanced optical diagnostics suites for							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsio</i>	n	<b>PROJECT</b> 623048: Co	<b>CT</b> : Combustion and Mechanical Systen				
B. Accomplishments/Planned Program (\$ in Millions)	·		1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.								
MAJOR THRUST: Develop, test, and qualify advanced turbine engine military specifications for aviation engine lubricants.	e lubricants. Generate and maintain	5.004	5.241	4.620	0.000	4.620		
<ul> <li>FY 2009 Accomplishments: In FY 2009: Demonstrated enhanced 5cSt ester lubricant in JSF Finalized new enhanced 5cSt oil specification. Began initial testing lubricant. Demonstrated an integrated bearing/oil health monitorin setting and validate life models. Fabricated and tested an efficient turbine engine components and adaptive components for high effi- high-temperature lubricants for Long Range Strike aircraft.</li> <li>FY 2010 Plans: In FY 2010: Complete testing of Joint Enhanced Ester oils in tech bearing endurance rigs and in XTE68/LF1 and XTE78/LF1 VAATI Finalize elastomer and load capacity limits jointly with US Navy, D ester oil specification and support initial transition activities to F-38</li> </ul>	g of new high-mach 7cSt ester g/prognostic system in full-scale mechanical system for ultra efficient iciency. Continued development of mology readiness level 5 full-scale E-I technology demonstrator engines.							
2-3 component level testing of high-Mach ester lubricant for future aircraft. Investigate anti-coke lube system surface modifiers using sustained supersonic engine oil system. Develop intelligent progn monitoring.	vapor phase coke (VPC) test rig for							
FY 2011 Base Plans: In FY 2011: Support full transition of Joint Enhanced Ester to F-3 coordinating with engine manufacturers and users. Conduct adap risk mitigation bearing and gear rig tests with Joint Enhanced Este engine test. Conduct TRL 3-4 component level testing of hi-Mach	tive components for high efficiency er in preparation for 2012 demo							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsio</i>	n	<b>PROJECT</b> 623048: Co	ombustion an	d Mechanica	al Systems
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Demonstrate anti-coke surface modifiers on sub-scale superso development of intelligent prognostics for lubrication system he						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and test advanced bearing material ter intermediate, and large-sized turbine engine applications.	5.069	5.500	4.719	0.000	4.719	
FY 2009 Accomplishments: In FY 2009: Continued sub-scale fatigue life and spall propaga validated spall propagation models with oil candidates and beg bearing evaluation to map out and transfer thermal models in s efficiency.	gin full-scale tests. Conducted full-scale					
FY 2010 Plans: In FY 2010: Investigate spall propagation of nitrided bearings. bearing heat generation models. Initiate fabrication of adaptive ultra efficient turbine engine mechanical systems components bearing concepts, such as foil bearings for high Mach missile a developing in-house rotor dynamic modeling expertise in supp efficiency, ultra efficient turbine engine components, and future	e components for high efficiency and and initiate risk mitigation tests. Test and other future applications. Continue ort of adaptive components for high					
FY 2011 Base Plans: In FY 2011: Investigate fatigue life and spall propagation of VI mechanical systems risk mitigation test activities for adaptive of coupled bearing & rotor dynamic models for virtual simulation engines. Continue developing reliable bearing technologies for limited-life engines. Note: In FY 2011, the efforts in this thrust	components for high efficiency. Develop of mechanical systems for advanced r sustained hi-mach reusable and					

				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsior</i>	ז	<b>PROJECT</b> 623048: Co	ombustion and	d Mechanica	l Systems
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO:  N/A.						
Acco	omplishments/Planned Programs Subtotals	24.134	18.841	18.679	0.000	18.679
	Ì	FY 2009	FY 2010	]		
		1.356	0.000	-		
Congressional Add: National Test Facility for Aerospace Fuels an	d Propulsion.	1.550	0.000			
FY 2009 Accomplishments: In FY 2009: Developed test capability for aerospace fuels and combustion testing.	d propulsion, focusing on alternative fuel/					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
Congressional Add: Hybrid Bearings		1.596	0.797	_		
Congressional Add: Hybrid Bearings. <i>FY 2009 Accomplishments:</i> In FY 2009: Completed crack propagation modeling of C-crac hybrid bearings. Completed full-scale bearing rig tests of light- bearing cages and CSS42L cages. Completed heat treat optin steel and fabrication of full-scale hybrid bearing hardware is u	-weight carbon-carbon composite mization of 2nd generation P675 bearing	1.596	0.797			
FY 2009 Accomplishments: In FY 2009: Completed crack propagation modeling of C-crac hybrid bearings. Completed full-scale bearing rig tests of light- bearing cages and CSS42L cages. Completed heat treat optir	-weight carbon-carbon composite mization of 2nd generation P675 bearing inderway.	1.596	0.797			

Exhibit R-2A, RDT&E Project Justif	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research								<b>PROJECT</b> 623048: Combustion and Mechanical Systems			
C. Other Program Funding Summa	ry (\$ in Milli	<u>ons)</u>	FY 2011	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	FY 2010	Base	000	Total	FY 2012	FY 2013	FY 2014	FY 2015		Total Cost
• PE 0601102F: <i>Defense</i> <i>Research Sciences.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602805F: <i>Dual Use Science</i> and Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603216F: Aerospace Propulsion and Power Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

#### **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-2A, RDT&E Project Justification: PB 2011 Air Force							DATE: February 2010				
	600: Research, Development, Test & Evaluation, Air Force			R-1 ITEM NOMENCLATURE       PROJECT         PE 0602203F: Aerospace Propulsion       623066: Turbine Engine Technol			e Technology	,			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
623066: Turbine Engine Technology	85.675	60.655	67.274	0.000	67.274	69.169	65.198	55.689	52.170	Continuing	Continuing

#### <u>Note</u>

Note: The funding in this project was increased in FY 2009 to provide emphasis on adaptive cycle technologies, increased fuel efficiency, and ultra efficient turbine engine components.

#### 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop core turbofan/turbojet engine components (i.e., compressors, combustors, and turbines) for fighters, bombers, sustained supersonic/hypersonic cruise vehicles, and transports.	63.346	42.506	41.097	0.000	41.097
<i>FY 2009 Accomplishments:</i> In FY 2009: Developed and applied advanced modeling and simulation rules and tools for advanced components. Conducted rig testing of advanced high pressure turbine vane and applied blade nano-laminate thermal barrier coating. Began developing computational fluid dynamics methodology for analyzing turbine flows. Began developing ceramic matrix composites lifing models. Conducted bench					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010						
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: Aerospace Propulsion		<b>PROJECT</b> 623066: <i>Tu</i>	<b>PROJECT</b> 623066: <i>Turbine Engine Technology</i>				
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 201 <sup>°</sup> Total		
and rig tests for validation of components with significantly imp of lightweight, simple, adaptive cycle features, an efficient, wic high temperature turbine capable of operating over large swing lightweight, low observable-compatible exhaust system. Fabric ratio compressor and associated thermal management feature in engine specific fuel consumption.	le-flow range compressor, an efficient, gs in required work and an efficient, cated an efficient, very high pressure							
FY 2010 Plans: In FY 2010: Develop and apply advanced modeling and simu components. Develop computational fluid dynamics methodol CMC lifing models. Conduct bench and rig tests for validation improved efficiency. Rig testing of lightweight, simple, adaptive range compressor, an efficient, high temperature turbine capa required work, and an efficient, lightweight, LO-compatible exh pressure ratio compressor and associated thermal management improvement in engine Specific Fuel Consumption (SFC.)	logy for analyzing turbine flows. Develop of components with significantly e cycle features, an efficient, wide-flow ble of operating over large swings in naust system. Rig test efficient, very high							
FY 2011 Base Plans: In FY 2011: Develop and apply advanced modeling and simu components. Develop computational fluid dynamics methodole ceramic matrix composite lifing models. Conduct bench and r significantly improved efficiency. Perform rig testing of lightwei an efficient, wide-flow range compressor, an efficient, high ten over large swings in required work, and an efficient, lightweigh system. Develop and apply advanced modeling and simulation and design of efficient, very high pressure ratio core compone change improvement in engine specific fuel consumption. No are reduced due to higher AF priorities.	bogy for analyzing turbine flows. Develop ig tests for validation of components with ight, simple, adaptive cycle features, inperature turbine capable of operating it, low observable-compatible exhaust in rules and tools to initiate definition int technologies that will offer a step							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsio</i>	n	<b>PROJECT</b> 623066: <i>Tu</i>	OJECT 3066: Turbine Engine Technology				
B. Accomplishments/Planned Program (\$ in Millions)	,		1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.								
MAJOR THRUST: Develop turbofan/turbojet engine components (i.e fighters, bombers, sustained supersonic strike and hypersonic cruise		15.773	14.485	19.237	0.000	19.237		
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Developed and applied advanced modeling and sim components. Developed durable damping/erosion coating system fan design for application to a variable cycle engine concept. Corpressure turbine design for application to a variable cycle engine lightweight, simple, LO-compatible inlet and exhaust system.</li> <li>FY 2010 Plans:</li> </ul>	ns. Conducted rig testing of advanced nducted rig testing of advanced low concept. Designed and rig tested							
In FY 2010: Develop and apply advanced modeling and simulatic components. Develop durable damping/erosion coating systems. design for application to a variable cycle engine concept. Conducturbine design for application to a variable cycle engine concept. compatible inlet and exhaust system.	Conduct rig testing of advanced fan t rig testing of advanced low pressure							
FY 2011 Base Plans: In FY 2011: Develop and apply advanced modeling and simulatic components. Develop durable damping/erosion coating systems. design for application to a variable cycle engine concept. Conduct turbine design for application to a variable cycle engine concept. compatible inlet and exhaust system.	Conduct rig testing of advanced fan t rig testing of advanced low pressure							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.								

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsic</i>	on	<b>PROJECT</b> 623066: <i>Turbine Engine Techno</i>					
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
MAJOR THRUST: Develop limited life engine components for mis applications, including long-range supersonic and hypersonic vehi		5.246	0.868	5.309	0.000	5.309		
FY 2009 Accomplishments: In FY 2009: Utilized data from high speed turbine engine test fed, dual-fuel CRC to update and validate advanced modeling								
FY 2010 Plans: In FY 2010: Develop and apply advanced modeling and simulimited life components. Design and rig test advanced limited efforts in this thrust are reduced due to higher AF priorities.								
FY 2011 Base Plans: In FY 2011: Develop and apply advanced modeling and simulimited life components. Design and rig test advanced limited efforts in this thrust are increased due to increased AF emphavehicle applications.	life components. Note: In FY 2011,							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.								
MAJOR THRUST: Develop components for turboshaft/turboprop a rotorcraft, special operations aircraft, and theater transports.	and small turbofan engines for trainers,	1.310	1.203	1.631	0.000	1.631		
FY 2009 Accomplishments: In FY 2009: Utilized data from efficient small scale engine tes centrifugal compressor, and a silicon nitride mixed flow turbing								

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			-	DATE: Febr	DATE: February 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsior</i>	n	<b>PROJECT</b> 623066: <i>Tu</i>	urbine Engine Technology			
B. Accomplishments/Planned Program (\$ in Millions)			l				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2010 Plans:</i> In FY 2010: Develop and apply advanced modeling and sim limited life components.	ulation rules and tools for advanced						
FY 2011 Base Plans: In FY 2011: Develop and apply advanced modeling and sim limited life components.	ulation rules and tools for advanced						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
Acc	omplishments/Planned Programs Subtotals	85.675	59.062	67.274	0.000	67.27	
		FY 2009	FY 2010	]			
		0.000	1.593				
FY 2009 Accomplishments:	lilitary Aircraft.						
<ul> <li>Congressional Add: Split Discharge Variable Delivery Pump for M FY 2009 Accomplishments: In FY 2009: Not applicable.</li> <li>FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort in Split Military Aircraft.</li> </ul>							

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVI 3600: Research, Development, Test BA 2: Applied Research		<b>R-1 ITEM N</b> PE 0602203			1	<b>PROJECT</b> 623066: <i>Tu</i>	bine Engine	Technology	/		
C. Other Program Funding Summary (\$ in Millions)											
			<u>FY 2011</u>	FY 2011	FY 2011					Cost To	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost
• PE 0601102F: <i>Defense</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Research Sciences.											
• PE 0602102F: <i>Materials.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603216F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Propulsion and Power Technology.											
• PE 0602122N: Aircraft	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology.											
• PE 0603210N: Aircraft	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Propulsion.											
• PE 0603003A: Aviation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Advanced Technology.			,	,			,				

#### **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, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010			
					<b>OMENCLA</b> 3F: <i>Aerospa</i>	TURE ce Propulsio	n	PROJECT 623145: Aerospace Power Technology				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
623145: Aerospace Power Technology	48.865	41.254	32.604	0.000	32.604	32.781	33.037	31.897	32.657	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop electrical power and thermal management component and subsystem technologies for manned and unmanned systems. Develop hybrid electrical power for special purpose applications.	23.182	25.620	27.521	0.000	27.52
FY 2009 Accomplishments: In FY 2009: Fabricated, integrated, and tested high efficiency, high power, wide temperature range power electrical components. Initiated integration and test air vehicle electromagnetic and radio frequency effects immune components. Integrated and tested thermal management components and subsystems.					
<i>FY 2010 Plans:</i> In FY 2010: Assess component performance objectives needed to meet systems level, energy optimized performance goals.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsio</i>	n	<b>PROJECT</b> 623145: <i>Ae</i>	ROJECT 23145: Aerospace Power Technolo			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 Base Plans: In FY 2011: Perform hardware-in-the-loop simulation tests to management systems provide continuous thermal balancing o mission profiles.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop lightweight electrical power and therm subsystem technologies with low volume displacement for delivery weapons.		1.398	1.119	1.103	0.000	1.10	
FY 2009 Accomplishments: In FY 2009: Investigated high-rate thermal energy storage for	directed energy applications.						
FY 2010 Plans: In FY 2010: Complete investigation of high-rate thermal energy applications.	gy storage for directed energy						
FY 2011 Base Plans: In FY 2011: Assess component technologies for application to	o directed energy weapon concepts.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop hybrid electrical power and thermal masteriage, components and subsystem technologies for special purp		4.039	4.159	3.980	0.000	3.98	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	n	<b>PROJECT</b> 623145: <i>Aerospace Power Technolog</i>				
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2009 Accomplishments: In FY 2009: Integrated and tested thermal management comp and initiated subsystems test of flight-weight, efficient, energy components.							
FY 2010 Plans: In FY 2010: Investigate and develop hybrid energy harvesting architectures. Integrate the energy harvesting technologies wit technologies. Integrate and test thermal management compor methods of energy harvesting and increased energy savings f Demonstrate long endurance flight tests of integrated systems	th novel battery, and fuel cell nents and subsystems. Implement or special purpose applications.						
FY 2011 Base Plans: In FY 2011: Develop increased fuel flexibility and integrated e expanded special purpose applications for improved power an flight-weight subsystems flight tests to demonstrate power and	d energy density. Perform integrated						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
Ассо	mplishments/Planned Programs Subtotals	28.619	30.898	32.604	0.000	32.604	
		FY 2009	FY 2010	]			
		1.197	0.000	-			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsic</i>	n	<b>PROJECT</b> 623145: <i>A</i> e	erospace Power Technology
3. Accomplishments/Planned Program (\$ in Millions)			1	
		FY 2009	FY 2010	
FY 2009 Accomplishments: In FY 2009: Continued development of micro fuel cell technolo applications. Continued improvements to balance of plant, rea- power density of the system and integrate into MAV vehicle.				
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Affordable Lightweight Power Supply Develop	0.997	0.000		
FY 2009 Accomplishments: In FY 2009: Developed novel high-performance and low-cost which are capable of operating at high temperatures, reduced system complexity. Demonstrated their ability to provide an im Fuel Cell system for US military/Air Force applications.	humidities and which enable decreased			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Electronics Liquid Cooling For Advanced Milita Projects.	ary Ground and Aerospace Vehicle	0.997	0.000	
FY 2009 Accomplishments: In FY 2009: Developed bonding processes required to fabrica for thermal management devices.	te aluminum macrolaminate cold plates			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsi</i>	on	<b>PROJECT</b> 623145: <i>Ae</i>	erospace Power Technology
B. Accomplishments/Planned Program (\$ in Millions)				
		FY 2009	FY 2010	]
Congressional Add: Integrated Aircraft Energy Management.		1.995	0.000	_
FY 2009 Accomplishments: In FY 2009: Integrated engine specifications, data, and propuluse in aircraft system design and modeling to develop an ener				
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Integrated Power for Aircraft Technologies (IN	IPACT II).	3.491	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted research to advance the state of the a technologies for aerospace applications.	art of energy, power and thermal			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Lithium Ion Domestic Materials Development.		1.596	0.000	
FY 2009 Accomplishments: In FY 2009: Synthesized, characterized, and scaled-up domen lithium ion batteries. First step in establishing a stable, domest cathodes with similar or improved performance characteristics	tic capability to produce high quality			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
		1.596	1.593	1

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsic</i>	on	<b>PROJECT</b> 623145: <i>A</i> e	erospace Power Technology
B. Accomplishments/Planned Program (\$ in Millions)				
		FY 2009	FY 2010	
Congressional Add: Advanced Lithium Battery Scale-Up and Manu	facturing.			
FY 2009 Accomplishments: In FY 2009: Completed lithium-ion cathode material selection a Conducted preliminary battery performance tests and complete				
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally directed effort in Advance Manufacturing.	ced Lithium Battery Scale-Up and			
Congressional Add: Energy Superior Lithium Battery Technology for	or Defense Applications.	5.983	1.593	
FY 2009 Accomplishments: In FY 2009: Developed a high energy nano cell design, a high applications, and developed a 270 V aircraft module using the batteries delivered to the different services for development, te	HP cell design. Sample production			
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally directed effort in Energy for Defense Applications.	Superior Lithium Battery Technology			
Congressional Add: Integrated Engine Starter/Generator.		1.596	1.593	•
FY 2009 Accomplishments: In FY 2009: Fabricated initial prototypes of the lightweight, cor generator and Inverter-Converter Controllers to increase the te				
FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort in Integra	ted Engine Starter/Generator.			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsio</i>	n	<b>PROJECT</b> 623145: <i>Ae</i>	erospace Power Technology
B. Accomplishments/Planned Program (\$ in Millions)			1	
		FY 2009	FY 2010	]
Congressional Add: Wavelength Agile Spectral Harmonic Oxygen	Sensor and Cell-Level Battery Controller.	0.798	1.195	
FY 2009 Accomplishments: In FY 2009: Continued to develop battery controlling/monitorin O2 sensor for potential fuel tank applications.	ng technology. Continued to develop an			
FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort in Wavele Sensor and Cell-Level Battery Controller.	ength Agile Spectral Harmonic Oxygen			
Congressional Add: High-Energy Li-Ion Technology for Aviation Ba	attorios	0.000	1.195	
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.	allenes.			
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally directed effort in High-E Batteries.	nergy Li-Ion Technology for Aviation			
Congressional Add: Thermal and Energy Management for Aerospa	ace.	0.000	3.187	-
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort in Therma Aerospace.	al and Energy Management for			
	Congressional Adds Subtotals	20.246	10.356	1

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVI 3600: Research, Development, Test BA 2: Applied Research		<b>R-1 ITEM NOMENCLATUREPROJ</b> PE 0602203F: Aerospace Propulsion62314					JECT 45: Aerospace Power Technology				
C. Other Program Funding Summa	ry (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	FY 2009	<u>FY 2010</u>	Base	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost
• PE 0601102F: <i>Defense</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Research Sciences.											
• PE 0602102F: Aerospace Flight	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dynamics.											
• PE 0602605F: Directed Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology.											
• PE 0602805F: Dual Use Science	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
and Technology.											
• PE 0603605F: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Weapon Technology.											
• PE 0603216F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Propulsion and Power Technology.											

#### **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, RDT&E Project Justification: PB 2011 Air Force							DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research					<b>IOMENCLA</b> 3F: <i>Aerospa</i>	TURE ce Propulsio	n	PROJECT 6233SP: Sp	DJECT BSP: Space Rocket Component Tech		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
6233SP: Space Rocket Component Tech	56.539	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

#### <u>Note</u>

Note: In FY 2010, work in this project was moved to Project 4847 within this Program Element 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.

#### **B. Accomplishments/Planned Program (\$ in Millions)**

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop, characterize, and test advanced hydrocarbons, energetics, solid propellant ingredients, and reduced-toxicity monopropellants to increase space launch payload capability.	4.241	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Continued evaluation and development of potential hydrocarbon fuel additives to improve performance of kerosene. Continued downselect process and continued scaling-up promising high energy-density materials candidates. Continued 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 motor tests. Continued exploration					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	)	PROJECT 6233SP: S	ECT P: Space Rocket Component Tec		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
and development of ionic liquids meeting Phase III goals. Initia for further characterization. Continued proof of concept for new molecular properties.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop advanced liquid engine combustion tech preserving chamber lifetime and reliability needs for engine uses in		8.120	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Characterized, studied, and evaluated shear inject injector compatibility and prevent damage to engines. Develop advanced combustion device technology, including injectors and or exceeding the IHPRPT Phase III goals. Developed improved combustion and fluid flow/heat transfer processes leading to ne management, scaling, and combustion instabilities in hydrocar reducing the need for conducting large numbers of costly full-s Evaluated novel nozzle cooling channels for use with hydrocar rig. Conducted validation and verification of advanced capability most promising advanced propulsion concepts; applied realisti performance. Refined experimental demonstrations of proof-of	ed, analyzed, and transitioned nd chambers capable of meeting d understanding of fundamental ew methodologies for thermal bon fueled liquid rocket engines, cale component and engine tests. bon fuels in the high heat flux test ties. Performed pre-selection of c computational models to optimize					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	1	PROJECT 6233SP: S	- Space Rocket Component Tech		
B. Accomplishments/Planned Program (\$ in Millions)			I			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
realistic computational models. Conducted system trade studi evaluate potential return on investment.	es with improved performance models to					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop advanced material applications for lig property enhancements for use in current and future rocket propul		6.215	0.000	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Developed new advanced ablative components and finalized processing parameters of new nano-reinforced H up processing of carbon-carbon materials. Developed new ac energy propellants. Explored using nanocomposites for liquid processing technology using multifunctional nanomaterials. C new class of hydrophobic and oleophobic materials.	high temperature polymers and scale- lvanced materials for use with high- rocket engine components and optimize					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsic</i>	on	PROJECT 6233SP: S	bace Rocket	Tech	
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop advanced liquid engine technologies for increasing life and reliability needs for engine uses in expendable a		21.918	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Continued enabling hydrocarbon boost technolog concepts. Developed engine health monitoring technologies su technology development effort. Developed advanced hydrocar other than kerosene that address IHPRPT Phase III goals.	upporting the hydrocarbon boost					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop solar electric, solar thermal, chemical, for station-keeping, repositioning, and orbit transfer for satellites an		5.474	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Conducted Hall thruster IHPRPT Phase III develo Phase III plasma thrusters for microsatellites propulsion syster Phase II and III monopropellants, evaluated advanced ignition Assessed advanced chemical propulsion technology developm	ns. Performed scale-up testing IHPRPT schemes and chamber concepts.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	n	<b>PROJECT</b> 6233SP: Space Rocket Component Tec				
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
component developments. Developed advanced multi-mode c satellites, down-selected to single design concept and began							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
Ассо	mplishments/Planned Programs Subtotals	45.968	0.000	0.000	0.000	0.00	
		FY 2009	FY 2010				
Congressional Add: Advanced Vehicle and Propulsion Center.		1.197	0.000				
FY 2009 Accomplishments: In FY 2009: Refined analytical tools helping assess feasibility boosters/engines across multiple launch platforms. Continued Prompt Global Strike, future ballistic missile development effor	model developments that will support						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
Congressional Add: Hydrocarbon Boost Technology Demonstrato	r	1.396	0.000				

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsi</i>	on	PROJECT 6233SP: SI	bace Rocket Component Tech
B. Accomplishments/Planned Program (\$ in Millions)			1	
		FY 2009	FY 2010	]
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Conducted additional modeling, simulation, and a which accelerate the development of technologies for highly of</li> <li>FY 2010 Plans:</li> <li>In FY 2010: Not Applicable.</li> </ul>	• • •			
				-
Congressional Add: Development and Testing of Advanced Paraff Applications.	in Based Hybrid Rockets for Space	2.792	0.000	
<i>FY 2009 Accomplishments:</i> In FY 2009: Continued to scale-up motors. Designed, built, an 30,000 pound thrust-class motors.	id initiated testing of 24-inch diameter,			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Integrated Propulsion Analysis Tool (IPAT).		1.995	0.000	-
FY 2009 Accomplishments: In FY 2009: Increased fidelity of rocket engine analysis and as application to advanced concepts being considered by the Air				
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Multi-Mode Space Propulsion.		0.798	0.000	

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fc	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 2: Applied Research		, Air Force			<b>OMENCLAT</b> F: <i>Aerospac</i>	-	ז	PROJECT 6233SP: Sp	ace Rocket	Component	Tech
B. Accomplishments/Planned Pro	gram (\$ in M	lillions)									
							FY 2009	FY 2010			
FY 2009 Accomplishments: In FY 2009: Provided added ris propulsion technology.	sk reduction e	efforts to exi	sting scope o	of work deve	loping multi-	mode					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
Congressional Add: Vortex Low Co	st Rocket En	gine.					2.393	0.000			
FY 2009 Accomplishments: In FY 2009: Developed small la improved performance and/or o		e that utilizes	s vortex com	bustion proc	esses to ger	erate					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
				Congre	ssional Add	s Subtotals	10.571	0.000			
C. Other Program Funding Summa	arv (\$ in Milli	ions)									
Line Item • PE Not Provided (7378): Activity Not Provided D. Acquisition Strategy Not Applicable	<b>FY 2009</b> 0.000	FY 2010 0.000	<u>FY 2011</u> <u>Base</u> 0.000	FY 2011 OCO 0.000	<u>FY 2011</u> <u>Total</u> 0.000	<u>FY 2012</u> 0.000	<u>FY 2013</u> 0.000	FY 2014 0.000	FY 2015 0.000	Cost To Complete 0.000	<u>Total Cos</u> 0.00

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		_	DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	PROJECT 6233SP: S	pace Rocket Component Tech

#### 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-2A, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
APPROPRIATION/BUDGET ACT 3600: Research, Development, To BA 2: Applied Research		n, Air Force			<b>IOMENCLA</b> 3F: <i>Aerospa</i>	TURE ce Propulsio	n	<b>PROJECT</b> 624847: <i>Rc</i>	ROJECT 4847: Rocket Propulsion Technology		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
624847: Rocket Propulsion Technology	9.449	75.582	58.954	0.000	58.954	61.231	61.141	62.337	63.534	Continuing	Continuing

#### <u>Note</u>

Note: Funding increase in FY 2010 and out due to multiple programs scheduled for major hardware scale-up and production in preparation for testing in the following years, and to feed technologies into the Hydrocarbon Boost Demo. These have been planned for and are expected. In FY 2010, funds from PE 0602203F Project 33SP have been moved to this project within this Program Element to more accurately align efforts.

#### 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.

#### B. Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop, characterize, and test advanced hydrocarbons, energetics, solid propellants, and monopropellants to increase space launch payload capability and refine new synthesis methods.	0.000	4.689	3.838	0.000	3.838
FY 2009 Accomplishments: In FY 2009: Not Applicable.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>		<b>PROJECT</b> 624847: <i>R</i> d	T Rocket Propulsion Technology			
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 201 Total	
FY 2010 Plans: In FY 2010: Perform screening analysis of potential hydrocark performance of kerosene. Proceed with downselect and scale- materials candidates. Evaluate scaled-up propellants in advan materials compatibility and performance to include supporting develop ionic liquids meeting IHPRPT Phase III goals. Initiate further characterization. Conduct proof of concept for new com properties of promising propellant ingredients. Evaluate suitab defense interceptor and spacecraft propulsion demonstrations for production of downselected propellants. Initiate high perfor program.	-up promising high energy-density ced combustion devices to determine large-scale motor tests. Explore and scale up of promising ionic liquids for nputational code to predict molecular ility for ionic liquid propellants for missile . Initiate technology transfer to industry						
FY 2011 Base Plans: In FY 2011: Conduct experimental and analytical evaluation of to improve performance of kerosene. Continue downselect pro- energy-density materials candidates. Evaluate scaled-up prop- to determine materials compatibility and performance to includ Exploration and development of ionic liquids meeting IHPRPT experiments of promising ionic liquids for further characterization new computational code to predict molecular properties of vari Continue evaluation of suitability for ionic liquid propellants for spacecraft propulsion demonstrations. Continue technology tra downselected propellants. Continue high performance bi-proper program.	becess and scale-up promising high ellants in advanced combustion devices le supporting large-scale motor tests. Phase III goals. Continue scale up on. Continue proof of concept for lous promising propellant ingredients. missile defense interceptor and ansfer to industry for production of						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research			<b>PROJECT</b> 624847: <i>Ro</i>	c Rocket Propulsion Technology			
B. Accomplishments/Planned Program (\$ in Millions)	'		1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
MAJOR THRUST: Develop advanced liquid engine combustion techno preserving chamber lifetime and reliability needs for engine uses in hea		0.000	8.401	7.125	0.000	7.125	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Characterize, study, and evaluate shear injector perfor compatibility and prevent damage to engines. Develop, analyze, are device technology, including injectors and chambers capable of me Phase III goals. Develop improved understanding of fundamental of transfer processes leading to new methodologies for thermal mana- instabilities in hydrocarbon fueled liquid rocket engines, reducing the numbers of costly full-scale component and engine tests. Evaluate for use with hydrocarbon fuels in the high heat flux test rig. Conduc- advanced capabilities. Perform pre-selection of most promising adv realistic computational models to optimize performance. Refine exp of-concepts, continue development of realistic computational model with improved performance models to evaluate potential return on	nd transition advanced combustion beeting or exceeding the IHPRPT combustion and fluid flow/heat agement, scaling, and combustion ne need for conducting large novel nozzle cooling channels et validation and verification of vanced propulsion concepts; apply berimental demonstrations of proof- els. Conduct system trade studies						
FY 2011 Base Plans: In FY 2011: Characterize, study, and evaluate shear injector perforinjector compatibility and prevent damage to engines. Validate studies chamber conditions and begin transition of predictive tools to indust advanced combustion device technology, including injectors and clexceeding the IHPRPT Phase III goals. Develop improved understa and fluid flow/heat transfer processes leading to new methodologies scaling, and combustion instabilities in hydrocarbon fueled liquid rook need for conducting large numbers of costly full-scale component advanced component advanced set.	dy results in more realistic rocket- try. Develop, analyze, and transition nambers capable of meeting or anding of fundamental combustion es for thermal management, ocket engines, reducing the						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>		<b>PROJECT</b> 624847: <i>R</i> d	ocket Propulsion Technology			
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
novel nozzle cooling channels for use with hydrocarbon fuels in validation and verification of advanced M&S capabilities. Perfor advanced propulsion concepts; apply realistic computational m experimental demonstrations of proof-of-concepts, continue de models. Conduct system trade studies with improved performan on investment.	m pre-selection of most promising odels to optimize performance. Refine velopment of realistic computational						
FY 2011 OCO Plans: In FY 2011 OCO:  N/A.							
MAJOR THRUST: Develop advanced material applications for lightweight components and material property enhancements for current and future rocket propulsion systems.		0.000	6.698	5.492	0.000	5.492	
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Develop new advanced ablative components using and refine processing parameters of new nano-reinforced high processing of carbon-carbon materials. Develop new advanced propellants. Continue to explore using nanocomposites for liqui optimize processing technology using multifunctional nanomate mechanisms behind a new class of hydrophobic and oleophobi opportunities.	temperature polymers and scale-up materials for use with high-energy d rocket engine components and rials. Characterize and understand the						
FY 2011 Base Plans: In FY 2011: Develop new advanced ablative components using characterize and finalize processing parameters of new nano-re and scale-up processing of carbon-carbon materials. Develop r	einforced high temperature polymers						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>		<b>PROJECT</b> 624847: <i>Ro</i>	T Rocket Propulsion Technology			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>high-energy propellants. Continue to explore applications of nar components and optimize processing technology using multifunc characterize and understand the mechanisms behind a new class materials exploring various transition opportunities.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A.</li> </ul>	ctional nanomaterials. Continue to						
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. <i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.		0.000	21.635	26.955	0.000	26.955	
<ul> <li>FY 2010 Plans:</li> <li>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. Initiate risk reduction activities for the development of hydrocarbon boost technologies. 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. Develop and demonstrate in-house, moderate scale liquid rocket component testing capability. Initiate evaluation of high performance compact liquid rocket engine technology. Initiate evaluation of bipropellant liquid rocket engine technologies.</li> </ul>							
FY 2011 Base Plans: In FY 2011: Develop enabling hydrocarbon boost technology fo risk reduction activities for the development of hydrocarbon boos of engine health monitoring technologies supporting the hydroca effort. Develop advanced hydrocarbon engine technologies usin	st technologies. Continue development irbon boost technology development						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>		<b>PROJECT</b> 624847: <i>Rc</i>	ocket Propulsion Technology		ogy	
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
address IHPRPT Phase III goals. Develop and demonstrate in-ho component testing capability. Develop high performance compact Continue development and evaluation of bipropellant technologies multiple programs scheduled for major hardware scale-up and pro <i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.	liquid rocket engine technologies. s. Note: Increase in FY 2011 due to						
MAJOR THRUST: Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for station-keeping, repositioning, and orbit transfer for satellites and satellite constellations. <i>FY 2009 Accomplishments:</i> In FY 2009: Not applicable.		0.000	6.976	5.391	0.000	5.391	
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Complete Hall thruster IHPRPT Phase III development efforts. Evaluate IHPRPT</li> <li>Phase III thrusters for microsatellites propulsion systems. Scale-up testing IHPRPT Phase II</li> <li>and III monopropellants, evaluate advanced ignition schemes and chamber concepts. Assess</li> <li>advanced chemical propulsion technology developments for satellite thrusters, continue component</li> <li>developments. Develop advanced multi-mode chemical-electric propulsion concepts for satellites,</li> <li>continue component developments. Develop next generation high power spacecraft propulsion. Initiate</li> <li>advanced modeling and simulation tool developments to improve design and analysis tools for a wide</li> </ul>							
FY 2011 Base Plans: In FY 2011: Evaluate IHPRPT Phase III plasma thrusters for micr Scale-up testing IHPRPT Phase II and III monopropellants, evalua and chamber concepts. Assess advanced chemical propulsion teo thrusters, continue component developments. Develop advanced	ate advanced ignition schemes chnology developments for satellite						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsic</i>	on	<b>PROJECT</b> 624847: <i>R</i> o	<b>CT</b> : Rocket Propulsion Technology				
B. Accomplishments/Planned Program (\$ in Millions)	1		1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
propulsion concepts for satellites, continue component develo power electric spacecraft propulsion. Continue advanced mod to improve design and analysis tools for a wide range of space	eling and simulation tool developments							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.								
MAJOR THRUST: Develop missile propulsion and boost technolo the Sustainment of Strategic Systems (TSSS) program.	gies. Efforts support the Technology for	5.712	7.102	7.641	0.000	7.64		
FY 2009 Accomplishments: In FY 2009: Conducted component development and risk red Propulsion demonstration. Used physics based modeling, sim analyze sub-scale components to help verify suitability of thos II Missile Propulsion demonstration. Verified development of ra using improved strategic propellants for future ballistic missiles Demonstrated low-cost, high temperature, non-erosive, lightwo and hybrid polymer components for solid rocket motors. Devel technologies.	ulation, and analysis tools to design and e technologies for use in TSSS Phase apid densification nozzle technology s to enhance performance and weight. eight coated carbon-carbon, ceramic							
FY 2010 Plans: In FY 2010: Continue component development and risk reduce Propulsion demonstration. Use physics based modeling, simu analyze sub-scale components to help verify suitability of thos II Missile Propulsion demonstration. Verify development of rap using improved strategic propellants for future ballistic missiles Demonstrate low-cost, high temperature, non-erosive, lightwei and hybrid polymer components for solid rocket motors. Devel	lation, and analysis tools to design and e technologies for use in TSSS Phase id densification nozzle technology s to enhance performance and weight. ight coated carbon-carbon, ceramic,							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsic</i>	on	<b>PROJECT</b> 624847: <i>Rocket Propulsion Technolog</i>					
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>technologies. Evaluate next generation of updated, physics-bas tools for missile propulsion components and applications.</li> <li>FY 2011 Base Plans: <ul> <li>In FY 2011: Continue the component development and risk rem</li> <li>Missile Propulsion demonstration. Demonstrate low-cost, high coated carbon-carbon, ceramic, and hybrid polymer componer advanced tactical propulsion technologies. Plan for the demonstechnologies under TSSS Phase II Missile Propulsion demonsteration of updated, physics-based moder missile propulsion components and applications.</li> </ul> </li> <li>FY 2011 OCO Plans: <ul> <li>In FY 2011 OCO: N/A.</li> </ul> </li> </ul>	eduction efforts for TSSS Phase II temperature, non-erosive, lightweight nts for solid rocket motors. Develop istration of advanced missile propulsion tration. Continue development and							
<ul> <li>MAJOR THRUST: Develop missile propulsion technologies and age ballistic missiles. Efforts support the Technology for the Sustainmer <i>FY 2009 Accomplishments:</i></li> <li>In FY 2009: Conducted advanced service life prediction technologies and advanced sensors to be attached to solid rocket r sensor data into existing aging and surveillance tool suite. Beg and surveillance technologies into demonstrations to validate a and accurately model motor behavior. Assessed next generatimodeling, simulation, and analysis tools, sensor schemes and tools.</li> </ul>	ent of Strategic Systems program. nology program. Developed and applied notors, and tools that can integrate gan efforts to integrate advanced aging and verify efforts to reduce uncertainties on of chemical and aging mechanism	2.939	3.351	2.512	0.000	2.512		

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	n	<b>PROJECT</b> 624847: <i>R</i> o	ocket Propuls	ion Technol	ogy
3. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans: In FY 2010: Conduct advanced service life prediction technologiand advanced sensors to be attached to solid rocket motors, a data into existing aging and surveillance tool suite. Continue efficiency model motor behavior. Continue development of nei mechanism modeling, simulation, and analysis tools, sensor set analysis tools.</li> <li>FY 2011 Base Plans: In FY 2011: Conduct advanced service life prediction technologiand advanced sensors to be attached to solid rocket motors, a data into existing aging and surveillance tool suite. Continue effective surveillance technologies into demonstrations to validate and variate and variate and variate and surveillance tool suite. Continue effective surveillance technologies into demonstrations to validate and variate accurately model motor behavior. Continue development of nei mechanism modeling, simulation, and analysis tools, sensor set analysis tools.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO Plans: In FY 2011 OCO: N/A.</li> </ul>	and tools that can integrate sensor fforts to integrate advanced aging and verify efforts to reduce uncertainties and ext generation of chemical and aging chemes and tools, and non-destructive by program. Develop and apply existing and tools that can integrate sensor fforts to integrate advanced aging and verify efforts to reduce uncertainties and ext generation of chemical and aging					
	mplishments/Planned Programs Subtotals	8.651	58.852	58.954	0.000	58.954
		0.001	00.002	00.004	0.000	
		FY 2009	FY 2010			
Congressional Add: Aerospace Lab Equipment Upgrade.		0.798	1.195			
Congressional Add. Acrospace Lab Equipment Opyrade.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propuls</i>	ion	<b>PROJECT</b> 624847: <i>R</i> c	ocket Propulsion Technology
B. Accomplishments/Planned Program (\$ in Millions)	l		1	
		FY 2009	FY 2010	]
FY 2009 Accomplishments: In FY 2009: Upgraded/augmented existing university facilities, engineers.	/capabilities to train future aerospace			
FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort in the Ae	rospace Lab Equipment Upgrade.			
Congressional Add: Advanced Vehicle Propulsion Center.		0.000	2.390	
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally directed effort at the Ad	vanced Vehicle Propulsion Center.			
Congressional Add: AFRL Edwards Rocket Test Stand 2-A Techni	ical Improvements.	0.000	3.187	
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort for AFRL Technical Improvements.	Edwards Rocket Test Stand 2-A			
Congressional Add: Development and Testing of Advanced Hybric	Rockets for Space Applications	0.000	2.788	
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.				

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsic</i>	n	<b>PROJECT</b> 624847: <i>R</i> c	ocket Propulsion Technology
B. Accomplishments/Planned Program (\$ in Millions)	'		1	
		FY 2009	FY 2010	]
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally directed effort in Develo Rockets for Space Applications.	opment and Testing of Advanced Hybrid			
Congressional Add: Integrated Propulsion Analysis and Spacecraf	t Engineering Tools (IPAT/ISET).	0.000	4.780	
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort in Integra Engineering Tools (IPAT/ISET).	ated Propulsion Analysis and Spacecraft			
Congressional Add: Multi-Mode Propulsion Phase IIA: High Perfor	mance Green Propellant.	0.000	1.593	-
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.				
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally directed effort in Multi-N Performance Green Propellant.	Node Propulsion Phase II-A: High			
Congressional Add: Next Generation Solar Electric In-Space Prop	ulsion.	0.000	0.797	-
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.				

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVI</b> 3600: Research, Development, Test BA 2: Applied Research		, Air Force		<b>R-1 ITEM N</b> PE 0602203	-	-	ז	<b>PROJECT</b> 624847: <i>Ro</i>	cket Propuls	sion Technolo	ogy
B. Accomplishments/Planned Prog	gram (\$ in M	lillions)						1			
		-					FY 2009	FY 2010			
FY 2010 Plans: In FY 2010: Conduct Congress Propulsion.	ionally direct	ed effort in N	Next Genera	ation Solar El	ectric In-Spa	ace					
				Congre	essional Add	s Subtotals	0.798	16.730			
C. Other Program Funding Summa	ary (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>		
• PE 0601102F: <i>Defense</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Research Sciences.											
• PE 0602114N: Power Projection	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Applied Research.											
• PE 0602303A: <i>Missile</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology.	0.000					0.000					
• PE 0602500F: <i>Multi-Disciplinary</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Space Tech. <ul> <li>PE 0603311F: Ballistic Missile</li> </ul>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0 000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology. • PE 0603401F: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Spacecraft Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
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, RDT&E Project Ju	stification: Pl	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>				<b>PROJECT</b> 625330: Aerospace Fuel Technology			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
625330: Aerospace Fuel Technology	0.000	6.880	6.679	0.000	6.679	6.234	6.572	6.568	6.544	0.000	0.000

#### <u>Note</u>

Note: The funding in this project was moved from PE 0602203F 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Conduct research and perform technical assessments of alternative hydrocarbon fuels derived from coal, natural gas, and biomass for use in legacy and advanced aerospace systems.	0.000	2.891	3.200	0.000	3.200
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
FY 2010 Plans: In FY 2010: Complete component evaluations of 50 percent synthetic paraffinic kerosene (SPK) produced by Fischer-Tropsch synthesis blended with 50 percent conventional aviation fuel. Conduct component "fit-for-purpose" evaluations of up to 100 percent SPK. Conduct initial evaluations of biomass derived aviation fuels, both blended with conventional aviation fuel and used 100 percent.					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsio</i>	on	<b>PROJECT</b> 625330: <i>Aerospace Fuel Technology</i>				
B. Accomplishments/Planned Program (\$ in Millions)	1						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
Assess analytical tools being developed to assess CO2 footpr alternative fuels.	int of coal and biomass derived						
FY 2011 Base Plans: In FY 2011: Complete component "fit-for-purpose" evaluation recommendation as to maximum SPK in blend use. Complete aviation fuels and assessment of associated CO2 footprint. Co as available fuel quantities permit.	initial evaluations of biomass derived						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop and demonstrate advanced component assessments of advanced aircraft integrated thermal and energy n aircraft.		0.000	0.800	1.100	0.000	1.10	
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Assess advanced aircraft thermal management of to improve the thermal characteristics of aviation fuels used in management systems. Develop advanced hydrocarbon based applicable to combined cycle engines.	integrated thermal and energy						
FY 2011 Base Plans: In FY 2011: Assess advanced aircraft thermal management of to improve the thermal characteristics of aviation fuels used in							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsio</i>	n	<b>PROJECT</b> 625330: Aerospace Fuel Technology					
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
management systems. Develop advanced hydrocarbon based applicable to combined cycle engines.	endothermic fuel technologies							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.								
MAJOR THRUST: Study and evaluate low-cost approaches to red Study fuel logistics vulnerabilities and develop detection and mitiga		0.000	1.000	1.000	0.000	1.000		
FY 2009 Accomplishments: In FY 2009: Not Applicable.								
FY 2010 Plans: In FY 2010: Assess aberrant logistical fuels to support field or corrective actions. Evaluate low cost fuel additives and assess Complete the development of experimental systems to simular systems and ground storage facilities and investigate possible	the impact on biological growth in fuel. te biological contamination in aircraft fuel							
FY 2011 Base Plans: In FY 2011: Assess aberrant logistical fuels to support field or novel corrective actions. Evaluate low cost fuel additives and a growth in fuel. Continue the investigation of actions to mitigate Investigate the development of biological mutations in fuel lead chemical biocides and antifungal agents.	assessment of the impact on biological the growth of biological agents in fuel.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.								
MAJOR THRUST: Develop and test advanced emissions diagnosis systems. Conduct evaluations of the combustion and emissions ch		0.000	0.883	1.379	0.000	1.379		

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602203F: <i>Aerospace Propulsion</i>	n	<b>PROJECT</b> 625330: <i>Ae</i>	PROJECT 25330: Aerospace Fuel Technology					
3. Accomplishments/Planned Program (\$ in Millions)			1						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total			
<ul> <li>FY 2009 Accomplishments: In FY 2009: Not Applicable.</li> <li>FY 2010 Plans: In FY 2010: Complete combustion emissions evaluations of his operating on 100 percent pure and blends of synthetic paraffini fuel and compare to analytical predictions. Develop diagnostic measurements and perform emissions evaluations on fielded e formation and composition. Initiate development of emissions of pressure combustor systems. Conduct preliminary assessment derived aviation fuels.</li> </ul>	c kerosene with conventional aviation protocols for aircraft ground emissions ngines to investigate particulate liagnostics applicable to advanced high								
<i>FY 2011 Base Plans:</i> In FY 2011: Develop diagnostic protocols for aircraft ground en emissions evaluations on fielded engines to investigate particu Develop emissions diagnostics applicable to advanced high pro- combustion emissions from biomass derived aviation fuels. Co emissions from blends of coal/biomass derived aviation fuels.	ate formation and composition.								
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.									
Accor	nplishments/Planned Programs Subtotals	0.000	5.574	6.679	0.000	6.679			
		FY 2009	FY 2010	]					
		0.000	1.306	-					
Congressional Add: National Test Facility for Aerospace Fuels Pro	pulsion.								

Exhibit R-2A, RDT&E Project J	ustification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET AC</b> 3600: Research, Development, 7 BA 2: Applied Research		Air Force		<b>R-1 ITEM NO</b> PE 0602203			ז	<b>PROJECT</b> 625330: <i>Ae</i>	el Technolog	У	
B. Accomplishments/Planned I	Program (\$ in Mi	llions)									
							FY 2009	FY 2010			
FY 2009 Accomplishments: In FY 2009: Not Applicable. FY 2010 Plans: In FY 2010: Conduct Congr		ed effort at t	he National	Test Facility	for Aerospa	ce Fuels					
Propulsion.				Congre	ssional Add	s Subtotals	0.000	1.306			
C. Other Program Funding Sun Line Item	nmary (\$ in Millio FY 2009	ons <u>)</u> FY 2010	<u>FY 2011</u> Base	<u>FY 2011</u> OCO	<u>FY 2011</u> Total	FY 2012	FY 2013	FY 2014	FY 2015	<u>Cost To</u> Complete	

			<u>FT 2011</u>	<u>FT 2011</u>	<u>F1 2011</u>					<u>COSL 10</u>	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<b>Base</b>	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost
• PE 0601102F: <i>Defense</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Research Sciences.											
• PE 0602805F: Dual Use Science	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
and Technology.											
• PE 0603216F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Propulsion and Power Technology.											

#### **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, RDT&E Budget Item	Justification	: PB 2011 A	ir Force						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research					<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>						
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	130.902	136.012	157.497	0.000	157.497	137.261	140.206	144.546	147.563	Continuing	Continuing
622002: Electronic Component Technology	36.556	40.251	34.458	0.000	34.458	43.702	44.670	51.281	52.895	Continuing	Continuing
622003: EO Sensors & Countermeasures Tech	18.447	18.603	21.430	0.000	21.430	28.644	29.756	30.694	31.299	Continuing	Continuing
6244SP: Space Sensors	8.438	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
624916: Electromagnetic Tech	17.470	19.056	18.905	0.000	18.905	0.000	0.000	0.000	0.000	Continuing	Continuing
626095: Sensor Fusion Technology	25.187	22.179	27.008	0.000	27.008	24.962	25.520	26.017	26.239	Continuing	Continuing
627622: RF Sensors & Countermeasures Tech	24.804	35.923	55.696	0.000	55.696	39.953	40.260	36.554	37.130	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, RDT&E Budget Item Justification: PB 2011 Air F	orce			DATE:	February 2010	)
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research		ITEM NOMENCLA 0602204F: Aerospa	-			
B. Program Change Summary (\$ in Millions)						
	<u>FY 2009</u>	<u>FY 2010</u>	FY 2011 Base	FY 2011 OCO	<u>FY 2011</u>	
Previous President's Budget	128.447	121.768	0.000	0.000		0.000
Current President's Budget	130.902	136.012	157.497	0.000	-	57.497
Total Adjustments	2.455	14.244	157.497	0.000	15	57.497
<ul> <li>Congressional General Reductions</li> <li>Congressional Directed Reductions</li> </ul>		0.000 0.000				
Congressional Directed Reductions     Congressional Rescissions	0.000	-0.576				
Congressional Adds	0.000	14.820				
Congressional Directed Transfers		0.000				
Reprogrammings	0.000	0.000				
SBIR/STTR Transfer	0.000	0.000				
Other Adjustments	2.455	0.000	157.497	0.000	15	57.497
Congressional Add Details (\$ in Millions, and Include	es General Re	eductions)		ſ	FY 2009	FY 2010
Project: 622002: Electronic Component Technology						
Congressional Add: Optically Pumped Atomic Laser	(OPAL).			-	2.792	0.000
Congressional Add: Low Voltage, Wideband Electro-	-Optic Polyme	er Modulator.		-	2.992	0.000
Congressional Add: Advanced Electronic Componer	nts for Sensor	Arrays.		-	0.000	2.390
Congressional Add: Advanced Integrated Microsyste	ms for Military	/ Electronic System	IS .	-	0.000	2.470
Congressional Add: On-Chip Integrated Photonic Po	olymer Transc	eiver.		-	0.000	4.481
		Cong	ressional Add Subtotal	s for Project: 622002	5.784	9.341
Project: 622003: EO Sensors & Countermeasures Tech	,			-		
Congressional Add: Super-resolution Sensor System	n (S3).			-	1.995	0.000
Congressional Add: Watchkeeper.				-	0.798	1.593
		Cong	gressional Add Subtotal	s for Project: 622003	2.793	1.593

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	e C	ATE: February 2010	)
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		
Congressional Add Details (\$ in Millions, and Includes G	eneral Reductions)	FY 2009	FY 2010
Project: 624916: Electromagnetic Tech		<u>.</u>	
Congressional Add: Wideband Digital Airborne Electroni	c Sensing Array (WDAESA).	2.393	0.000
	Congressional Add Subtotals for Project: 624	916 2.393	0.000
Project: 626095: Sensor Fusion Technology			
Congressional Add: Sensor Fusion.		2.394	0.000
Congressional Add: Advanced Data Exploitation and Vis	ualization.	0.798	0.000
Congressional Add: Information Quality Tools for Persist	ent Surveillance Data Sets.	1.596	1.434
Congressional Add: Net-Centric Sensor Grids.		0.798	2.390
Congressional Add: Persistent Sensing Data Processing	, Storage and Retrieval.	1.596	0.000
	Congressional Add Subtotals for Project: 626	6095 7.182	3.824
Project: 627622: RF Sensors & Countermeasures Tech			
Congressional Add: Weather Sensors for Cursor On Tar	get.	1.596	0.000
	Congressional Add Subtotals for Project: 627	7622 1.596	0.000
	Congressional Add Totals for all Proj	ects 19.748	14.758

#### **Change Summary Explanation**

Note: In FY 2010, Congress added \$2.4 million for Advanced Electronic Components for Sensor Arrays, \$2.48 million for Advanced Integrated Microsystems for Military Electronic Systems, \$1.44 million for Information Quality Tools for Persistent Surveillance Data Sets, \$2.4 million for Net-Centric Sensor Grids, \$4.5 million for On-Chip Integrated Photonic Polymer Transceiver, and \$1.6 million for Watchkeeper. The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner. C. Performance Metrics

Under Development.

Exhibit R-2A, RDT&E Project Jus	stification: Pl	3 2011 Air F	orce						DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research								<b>PROJECT</b> 622002: Electronic Component Technology				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
622002: Electronic Component Technology	36.556	40.251	34.458	0.000	34.458	43.702	44.670	51.281	52.895	Continuing	Continuing	

#### <u>Note</u>

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 (ISR), 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop compact, affordable, multi-function components for aerospace sensors. Develop advanced electronic and optoelectronic aperture subsystems for affordable and scalable sensors.	12.478	6.368	9.975	0.000	9.975
FY 2009 Accomplishments: In FY 2009: Demonstrated integrated wideband subarray for future multi-intelligence electronic warfare and radar applications. Designed and developed digital receiver components to enable full digital receiver and exciter capabilities per transmit/receive site to enable future software-controlled phased arrays. Developed new hardware to exploit emerging metamaterials for compact radiating					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 622002: <i>El</i>	<b>ROJECT</b> 2002: Electronic Component Technology				
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
sensor applications including conformal array antennas and el Evaluated the potential for highly-integrated electronics and ap interference integrated devices and circuits through the use of electronic building blocks, including laboratory prototyping of e elements.	pertures using low electromagnetic metamaterials as three-dimensional							
FY 2010 Plans: In FY 2010: Demonstrate prototype wideband digital channel. metamaterials for electronic and optoelectronic applications. I most promising metamaterials technology.								
FY 2011 Base Plans: In FY 2011: Demonstrate and transition sensing and/or electro metamaterials approaches.	onic warfare subsystem using							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.								
MAJOR THRUST: Develop new microelectronic component and fa communications to support ISR, precision strike, and battlespace a		6.315	4.255	4.692	0.000	4.692		
FY 2009 Accomplishments: In FY 2009: Fabricated and lab tested physical and chemical models to predict failure modes and lifetimes. Further refined techniques. Demonstrated flexible and visually-transparent ra	electronics modeling and assessment							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 622002: <i>El</i>	T Electronic Component Technolog				
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Demonstrate closed-loop modeling and prediction device performance versus lifetime in militarily relevant environ electronic device concepts for wideband, reconfigurable and tu</li> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Demonstrate predictive capability for a larger varied predictity for a larger</li></ul>	ments. Investigate and test innovative nable applications. ety of emerging electronic devices to							
map performance versus lifetime in military relevant environme for previously prioritized electronic device technologies and the chemistry. Fabricate and test innovative electronic device cond tunable applications. FY 2011 OCO Plans:	ir corresponding accelerants and							
In FY 2011 OCO: N/A.								
MAJOR THRUST: Develop optoelectronics for next generation ima Develop electro-optical devices for next-generation warfighter applied		5.012	. 3.817	4.692	0.000	4.692		
FY 2009 Accomplishments: In FY 2009: Developed vertical external cavity surface emitting brightness sources. Completed development of fiber-optics an mid-infrared applications. Developed ultra-stable, tunable, mod integrated optical waveform generation.	d optical components for high-power							
FY 2010 Plans: In FY 2010: Demonstrate compact, efficient, high-brightness se pumped. Start the development for compact, tunable detector applications. Continue development of optical waveform gener	technology for advanced multi-spectral							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 622002: <i>El</i>	ectronic Com	ponent Tech	nnology
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>combined spectral and polarimetric filtering at detector pixel leg spectro-polarimetric focal plane array development.</li> <li><i>FY 2011 Base Plans:</i></li> <li>In FY 2011: Continue development of agile/affordable advanc on combined spectro-polarimetric filtering. Start integration and brightness and agile waveform sources for integration into combined spectro.</li> </ul>	ed detector arrays with emphasis d application development of high-					
FY 2011 OCO Plans: In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop, fabricate, and test electronic and optor reduce power loss and power consumption for future imaging, elect <i>FY 2009 Accomplishments:</i> In FY 2009: Developed tunable and reconfigurable wideband and electronic warfare sensors. Emphasized emerging electronic circuit applications.	tronic warfare, and ISR sensors.	2.629	8.689	8.024	0.000	8.02
FY 2010 Plans: In FY 2010: Demonstrate tunable and reconfigurable electronic combined imaging and electronic warfare applications. Contin starved applications.						
FY 2011 Base Plans: In FY 2011: Refine and transition solutions for multi-function e components for imaging and electronic warfare applications.	electronic and optoelectronic					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 622002: <i>Ele</i>	ectronic Com	ponent Tech	nology
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate innovative radio-frequencies system cost through reduction of part count, chip size, and design,		2.169	1.013	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Developed and demonstrated highly integrated ph wideband multi-function sensors.	nase control components for use in					
FY 2010 Plans: In FY 2010: Design and develop highly reconfigurable fully pro- flexible optoelectronic integrated circuits using highly integrated frequency and optical apertures.	•					
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable. Effort eliminated due to higher Air	r Force priorities.					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop integrated design, modeling and simula complex mixed-signal component development in advanced electron		2.169	5.127	5.670	0.000	5.670
FY 2009 Accomplishments: In FY 2009: Demonstrated closed loop characterization of per- design, fabrication, and characterization with first pass success	•					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 622002: <i>El</i>	ectronic Com	tronic Component Technology		
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2010 Plans: In FY 2010: Extend design and characterization capability to t function electronic and optoelectronic devices and component							
FY 2011 Base Plans: In FY 2011: Employ design, modeling, and simulation tools ar mixed-technology (digital, radio-frequency, microwave, optical in both advanced and emerging electronic component technol	, mechanical) component development						
FY 2011 OCO Plans: In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop advanced component and subsystem focuses on improving performance and reducing size, mass, and p	•	0.000	1.641	1.405	0.000	1.40	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Develop reconfigurable/tunable high performance space qualification issues associated with newer component to accurate transitions. Develop scalable/reconfigurable plug-an	echnologies to ensure more rapid and						
FY 2011 Base Plans: In FY 2011: Continue to develop reconfigurable/tunable high development of space qualified adaptive/intelligent electronics (C-SWAP) phased array antenna producibility effort.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 622002: <i>Ele</i>	ectronic Com	ponent Tech	nology
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
Ассо	mplishments/Planned Programs Subtotals	30.772	30.910	34.458	0.000	34.45
		FY 2009	FY 2010			
		2.792	0.000	-		
Congressional Add: Optically Pumped Atomic Laser (OPAL).						
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for the	OPAL.					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
Congressional Add: Low Voltage, Wideband Electro-Optic Polyme	r Modulator	2.992	0.000	-		
<i>FY 2009 Accomplishments:</i> In FY 2009: Conducted Congressionally-directed effort for Lov Polymer Modulator.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
Congressional Add: Advanced Electronic Components for Sensor	Arrays	0.000	2.390			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			1	DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 622002: <i>Ele</i>	ectronic Component Technology
B. Accomplishments/Planned Program (\$ in Millions)	· · · ·		1	
		FY 2009	FY 2010	]
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Adva Arrays.	nced Electronic Components for Sensor			
		0.000	2.470	
Congressional Add: Advanced Integrated Microsystems for Military	y Electronic Systems .			
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Adva Military Electronic Systems.	nced Integrated Microsystems for			
		0.000	4.481	
Congressional Add: On-Chip Integrated Photonic Polymer Transc	eiver.			
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally-directed effort for On-C Transceiver.	Chip Integrated Photonic Polymer			
	Congressional Adds Subtotals	5.784	9.341	1

Exhibit R-2A, RDT&E Project Justi					DATE: Feb	ruary 2010					
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				<b>R-1 ITEM NO</b> PE 0602204			<b>PROJECT</b> 622002: <i>Electronic Component Tec</i>				
C. Other Program Funding Summa	FY 2011	FY 2011	FY 2011					Cost To			
Line Item	FY 2009	FY 2010	Base	0CO	Total	FY 2012	FY 2013	FY 2014	FY 2015		Total Cost
• PE Not Provided (8720): Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602500F: Multi-Disciplinary Space Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603203F: Advanced Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

#### **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-2A, RDT&E Project Justification: PB 2011 Air Force										DATE: February 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research					IOMENCLA <sup>-</sup> 4F: <i>Aerospa</i>			<b>PROJECT</b> 622003: EO Sensors & Countermeasures Te				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
622003: EO Sensors & Countermeasures Tech	18.447	18.603	21.430	0.000	21.430	28.644	29.756	30.694	31.299	Continuing	Continuing	

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop technology for non-cooperative detection and identification of airborne and ground-based targets.	2.719	2.334	10.972	0.000	10.972
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Performed sensor concept demonstrations for multi-discriminant active and passive sensing and quantified expected system performance. Characterized target discrimination and shape extraction performance using passive multispectral and polarimetric sensing techniques. Demonstrated hybrid focal planes and read-out electronics for simultaneous multi-discriminant active and passive sensing, and refined image processing techniques for sensor data enhancement. Performed trade-off studies for long range target identification using passive and active techniques, including polarimetric discrimination and synthetic aperture laser radar.</li> </ul>					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>	<b>PROJECT</b> 622003: <i>E</i> 0	<b>T</b> EO Sensors & Countermeasures Tech			
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Perform sensor concept demonstrations for long rand active techniques, including multispectral/polarimetric image synthetic aperture laser radar. Develop fused active and passibased on individual and combined measurement performance. focal planes and demonstrate in short range ladar systems. Busystem utilizing common components to minimize size and optenhancements for improved space situation awareness experiment performance, including multispectral/polarimetric image and active techniques, including multispectral/polarimetric image and synthetic aperture laser radar. Refine techniques for long either multi-aspect multispectral and polarimetric images or comphasis on synthetic and sparse aperture imaging technique experiments with multispectral/polarimetric imaging systems to concept experiments to assess potential utility.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A.</li> </ul>	ging, vibrometry, sparse aperture and ve, multi-discriminant image products Continue characterization of hybrid egin design of multi-discriminant imize utility. Continue optical sensor ments. range target identification using passive ging, vibrometry, 3-D, sparse aperture range object reconstruction based on herent laser radar data, with particular s. Continue signature collection					
MAJOR THRUST: Develop optical transmitter and agile aperature target characteristics for robust non-cooperative target identification		5.009	0.512	1.262	0.000	1.262
FY 2009 Accomplishments: In FY 2009: Developed and tested optical transmitter technoloc identification at long standoff ranges. Performed multi-function identification including shape, polarization, and vibration using sensing techniques. Completed development of sparse apertu	signature collections for long-range real-beam and synthetic aperture					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 622003: <i>E</i> C	ECT 3: EO Sensors & Countermeasures Teo			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		sor buds		FY 2011 Base	FY 2011 OCO	FY 2011 Total	
imaging. Developed optimal system concepts using advanced a Continued tower and flight collections to quantify expected performance components for a long-range demonstration system.							
FY 2010 Plans: In FY 2010: Complete testing of optical transmitter technologies identification at long standoff ranges. Continue to refine optima active and passive sensor models with emphasis on imaging the and foliage. Develop enabling sensor components for a demon	l system concepts using advanced rough scattering media such as clouds						
FY 2011 Base Plans: In FY 2011: Initiate development of beamsteering technology for compact 3-D laser radar systems. Assess characteristics of bea based on liquid crystal, micro electro-mechanical systems, and	amsteering component technologies						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop innovative techniques and components environments, including dynamic targets in urban areas.	to target difficult objects in battlefield	4.499	6.067	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Developed techniques for targeting difficult objects Performed concept demonstrations of continuous passive infrar with detection and tracking of dynamic targets and events. Dev for optimizing revisit rate and performed design trade-off experin close-in sensing from UAV or small UAVs in difficult environmer aerial vehicles (SUAV) applications of non-mechanical beam ste Performed spectral, spatial, polarimetric, and radiometric signat	ed surveillance of broad areas eloped sensor concept designs ments. Developed concepts for nts. Investigated small unmanned eering for pointing and stabilization.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>	<b>PROJECT</b> 622003: <i>E</i> 0	O Sensors & Countermeasures Tech			
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>laboratory passive and active laser detection and ranging sense track association in dense target areas.</li> <li>FY 2010 Plans:</li> <li>In FY 2010: Continue development of techniques for targeting environments. Explore compact active and passive sensor comprocessing for distributed operation from small platforms to provin obscured and urban areas. Demonstrate individual sensor complexity of the sensor compl</li></ul>	difficult objects in dynamic urban ponents with advanced signal vide close-in sensing of difficult targets					
<ul> <li>from SUAVs in difficult environments. Conduct flight phenomer applications on SUAVs.</li> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Not Applicable. Effort eliminated due to higher Air</li> </ul>	nology experiments supporting ladar					
FY 2011 OCO Plans: In FY 2011 OCO:  N/A.						
MAJOR THRUST: Develop countermeasure technologies for use a guided missiles threats.	gainst infrared- and electro-optical	2.732	7.640	8.469	0.000	8.469
FY 2009 Accomplishments: In FY 2009: Evaluated countermeasure techniques to defeat se missile seekers. Developed new countermeasure technique up legacy systems. Identified discriminants for specific identification missile threats.	dates and refinements applicable to					
FY 2010 Plans: In FY 2010: Assess technologies to defeat advanced infrared r sensors. Support demonstration of proactive detection, discrim						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>	<b>PROJECT</b> 622003: <i>E</i> 0	<b>CT</b> : EO Sensors & Countermeasures Tecl			
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>generation infrared-imaging missile seekers and sensors systered iscrimination processes test data. Develop and refine simulation across mission concepts of employment.</li> <li>FY 2011 Base Plans: <ul> <li>In FY 2011: Continue the assessment of advanced infrared m Continue to develop proactive infrared countermeasures include defeat of second-generation, infrared, imaging missile seekers and simulation capability to assess effectiveness of countermeasure of employment.</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: N/A.</li> </ul> </li> </ul>	tion capability to evaluate effectiveness issiles and infrared acquisition sensors. ling the detection, discrimination, and and sensors systems. Refine modeling					
MAJOR THRUST: Develop aerospace missile and laser warning te countermeasures.	echnologies to accurately cue	0.695	0.457	0.727	0.000	0.727
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Developed new laser warning sensor technologie laser threats. Identified clutter suppression techniques to incre detection ranges in urban operations. Evaluated algorithms to ranges.</li> </ul>	ease signal to noise and improve					
FY 2010 Plans: In FY 2010: Support integration of new laser warning sensors prototypes to provide robust capability to detect threats and cu hardware and software design based on test data. Conduct de capabilities. Develop new laser warning concepts to address e	e defeat techniques. Refine sensor emonstration testing of integrated					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 622003: <i>EC</i>	) Sensors &	Countermea	sures Tech
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Demonstrate integrated beam rider laser, direct ta detection sensors supporting proactive infrared countermeasur						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
Accor	nplishments/Planned Programs Subtotals	15.654	17.010	21.430	0.000	21.430
		FY 2009	FY 2010	]		
Congressional Add: Super-resolution Sensor System (S3).		1.995	0.000			

Congressional Add: Super-resolution Sensor System (S3).		
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for the Super-resolution Sensor System.		
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.		
Congressional Add: Watchkeeper.	0.798	1.593
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for the Watchkeeper.		
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Watchkeeper.		
Congressional Adds Subtotals	2.793	1.593

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVI 3600: Research, Development, Test of BA 2: Applied Research	R-1 ITEM NOMENCLATURE PE 0602204F: Aerospace SensorsPROJEC 622003:					ECT 3: EO Sensors & Countermeasures Tech					
C. Other Program Funding Summa	ry (\$ in Mill	ions)	EV 0044	EV 0044	EV 0044						
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	<u>000</u>	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost
• PE Not Provided (8997): Activity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Not Provided											
• PE 0602500F: <i>Multi-Disciplinary</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Space Technology.											
• PE 0603253F: Advanced Sensor	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Integration.	0.000	0.000	5.000	5.000	0.000	0.000	5.000	0.000	0.000	0.000	0.000

#### **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-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research								<b>PROJECT</b> 6244SP: <i>Space Sensors</i>				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	OCO Total FY 2012 FY 2013			FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
6244SP: Space Sensors	8.438	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing	

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop hybrid space-based sensor solutions to be responsive to space needs and detect difficult targets. Develop jam-resistant space-qualified time, position, and velocity sensors.	2.600	0.000	0.000	0.000	0.000
<i>FY 2009 Accomplishments:</i> In FY 2009: Experimentally assessed responsive "plug-and-play" satellite implementation concept. Designed size-, weight-, and power-restricted precision time, position, and velocity sensor techniques for space-based applications. Demonstrated constructive systems engineering model to assess space-based assured reference techniques in terms of measures of performance and warfighter utility.					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 6244SP: Space Sensors				
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop advanced active phased array antennu unique requirements of affordable space-based sensing including it		2.118	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Experimentally assessed enhanced antenna sign	al interference compatibility capability.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Study adaptive processing techniques for large arrays to meet the demands of wide area sensing in severe clutter		0.978	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Integrated the developed algorithms, waveforms, surveillance network of sensors.	and space platform scenarios into a						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>	5	<b>PROJECT</b> 6244SP: Space Sensors				
B. Accomplishments/Planned Program (\$ in Millions)			.1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 Base Plans: In FY 2011: Not Applicable.							
FY 2011 OCO Plans: In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop advanced component technology for s improving performance and reducing size, mass, and prime power	•	1.425	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Developed compact tunable filters for interference environments.	e signal rejection in dense signal						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop sensor techniques to achieve highly a performance for hypersonic air vehicles in prompt global strike app		1.317	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Designed a radio-frequency hardware-in-the-loop air vehicle plasma characteristics, platform trajectories, and his techniques for space-based applications. Developed a constr assess hypersonic navigation techniques in terms of measure	ghly accurate and robust navigation uctive systems engineering model to						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force								DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				<b>R-1 ITEM NO</b> PE 0602204	-	-		PROJECT 6244SP: Space Sensors			
B. Accomplishments/Planned Pro	gram (\$ in N	lillions <u>)</u>						1			
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans:											
In FY 2010: Not Applicable.											
FY 2011 Base Plans:											
In FY 2011: Not Applicable.											
FY 2011 OCO Plans: In FY 2011 OCO: N/A.											
			Accomplish	ments/Plann	ed Program	s Subtotals	8.438	0.000	0.000	0.000	0.00
C. Other Program Funding Summ	ary (\$ in Mill	ions)									
		<b>r</b>	<u>FY 2011</u>	FY 2011	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cos
• PE Not Provided (9214): Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0602500F: <i>Multi-Disciplinary</i> Space Tech.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0603203F: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0603203F: Advanced Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

#### 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, RDT&E Project Justification: PB 2011 Air Force							DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research					IOMENCLA <sup>-</sup> 4F: <i>Aerospa</i>			<b>PROJECT</b> 624916: <i>Electromagnetic Tech</i>			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
624916: Electromagnetic Tech	17.470	19.056	18.905	0.000	18.905	0.000	0.000	0.000	0.000	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
2.462	3.131	3.489	0.000	3.489
-			FY 2009 FY 2010 Base	FY 2009 FY 2010 Base OCO

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 624916: <i>Ele</i>	<b>JECT</b> 16: <i>Electromagnetic Tech</i>				
B. Accomplishments/Planned Program (\$ in Millions)	1		I					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
physics-based and data dependent electromagnetic models o diversity and dynamic sensor responses to the evolving proble	•							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.								
MAJOR THRUST: Design and develop antennas for airborne and space-based surveillance. Develop metamaterials for conformal arrays.		6.174	6.777	6.255	0.000	6.255		
FY 2009 Accomplishments: In FY 2009: Developed new low-cost digital beamforming tec vehicles. Integrated new detection algorithm with low cost see new conformal digital beamforming phased array antennas or new hardware to exploit emerging metamaterials for compact conformal array antennas and electronics based upon comple obtaining metamaterial properties consistent with the demons based upon radio frequency integrated circuit applications to e element device drivers.	eker hardware. Integrated and tested airborne radar platforms. Developed radiating sensor applications including x media. Assessed the viability of tration of highly integrated subsystems							
FY 2010 Plans: In FY 2010: Continue to develop new low-cost digital beamfo unmanned aerial vehicles. Integrate new detection algorithm Continue integration and test of new conformal digital beamfo airborne radar platforms. Continue to develop new hardware compact radiating sensor applications including conformal arr upon complex media. Continue to assess the viability of obtain with the demonstration of highly integrated subsystems based applications to enable small, highly directional antenna eleme	with low cost seeker hardware. rming phased array antennas on to exploit emerging metamaterials for ay antennas and electronics based ning metamaterial properties consistent							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force	1		1	DATE: Feb	ruary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 624916: <i>El</i>	: Electromagnetic Tech				
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Continue integration of new detection algorithm wintegration and test of new conformal digital beamforming pha platforms. Continue to develop new hardware to exploit emersensor applications including conformal array antennas and el Continue to assess the viability of obtaining metamaterial proport highly integrated subsystems based upon radio frequency in small,</li> <li>highly directional antenna element device drivers.</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: N/A.</li> </ul>	sed array antennas on airborne radar ging metamaterials for compact radiating lectronics based upon complex media. perties consistent with the demonstration							
MAJOR THRUST: Design and develop new electro-optical technic identifying concealed targets.	ques and components for detecting and	3.654	5.500	5.456	0.000	5.45		
FY 2009 Accomplishments: In FY 2009: Developed new quasi-phase matched materials s techniques for efficient optical sources in the mid- and long-wa systems were developed to enable conversion from pump way Tested integrated focal plane arrays.	ave infrared applications. New materials							
FY 2010 Plans: In FY 2010: Continue to develop new quasi-phase matched n and techniques for efficient optical sources in the mid- and lon developing new materials systems to enable conversion from microns. Continue testing of integrated focal plane arrays.	ng-wave infrared applications. Continue							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 624916: <i>Ele</i>	ECT 6: Electromagnetic Tech		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Continue to develop new quasi-phase matched matched techniques for efficient optical sources in the mid- and long-way new materials systems to enable conversion from pump waveled Conclude testing of integrated focal plane arrays.	e infrared applications. Demonstrate					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop hardware and software for passive multi infrared spectral wavelength range at high frame rates.	i-dimensional sensing in the thermal	2.787	3.648	3.705	0.000	3.705
FY 2009 Accomplishments: In FY 2009: Developed new electro-optical sensor hardware for radioactive, nuclear, or high explosive weapons using spectral/l initial testing to assess sensor detection and identification viabil Developed hyperspectral and multispectral sensors and create for moving into transition with an advanced technology demons hyperspectral sensors for collecting data at millisecond sample	hyperspectral intelligence. Performed ity and initiate plan for transition. a small, deployable instrument suitable trator. Initiated utility assessment of					
FY 2010 Plans: In FY 2010: Continue to develop new electro-optical sensor ha biological, radioactive, nuclear, or high explosive weapons usin Continue testing to assess sensor detection and identification v Continue development of hyperspectral and multispectral sensor instrument suitable for moving into transition with an advanced utility assessment of hyperspectral sensors for collecting data a based applications. Apply spectral temporal sensor technology persistent surveillance sensors.	g spectral/hyperspectral intelligence. iability and initiate plan for transition. ors and create a small, deployable technology demonstrator. Continue t millisecond sample rates for space-					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 624916: <i>El</i>	ectromagneti	c Tech	
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans: In FY 2011: Continue development of electro-optical sensor h biological, radioactive, nuclear or high explosive weapons usin intelligence. Continue development of chemical biological star spectral temporal sensor demonstration for cueing electro-opti sensors.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: Not applicable.</li> </ul>	g spectral or spectral temporal ndoff detection hardware. Complete					
Acco	mplishments/Planned Programs Subtotals	15.077	19.056	18.905	0.000	18.90
		FY 2009	FY 2010	]		
Congressional Add: Wideband Digital Airborne Electronic Sensing FY 2009 Accomplishments:		2.393	0.000			
In FY 2009: Conducted Congressionally-directed effort for WE FY 2010 Plans:	JAEOA.					

Congressional Adds Subtotals

2.393

0.000

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce					DATE: February 2010				
APPROPRIATION/BUDGET ACTIVI 3600: Research, Development, Test BA 2: Applied Research		, Air Force		<b>R-1 ITEM NO</b> PE 0602204				<b>PROJECT</b> 624916: <i>Ele</i>	ectromagneti	c Tech		
C. Other Program Funding Summa	ury (\$ in Mill	ions)	FY 2011	FY 2011	FY 2011					Cost To		
Line Item	FY 2009	FY 2010	Base	000	Total	FY 2012	FY 2013	<u>FY 2014</u>	FY 2015	Complete	<b>Total Cost</b>	
• PE Not Provided (9431): <i>Activity Not Provided</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0602500F: <i>Multi-Disciplinary Space Technology.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

## **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, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 2: Applied Research		n, Air Force					<b>PROJECT</b> 626095: Sensor Fusion Technology				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
626095: Sensor Fusion Technology	25.187	22.179	27.008	0.000	27.008	24.962	25.520	26.017	26.239	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 sensor; 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and assess single and multi-sensor automatic target recognition (ATR) and sensor fusion algorithms for rapidly finding, tracking, and targeting mobile targets.	1.387	2.010	7.261	0.000	7.261
FY 2009 Accomplishments: In FY 2009: Assessed 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. Developed and validated multi-sensor/multi-					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010						
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 626095: Se	nsor Fusion	Technology			
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 201 Total		
frequency synthetic data generation tools required to augment development, and operational data sets. Initiated development other phenomenological features that heretofore have not bee tests and assessment of multi-sensor and sensor fusion algori weapon delivery systems. Enhanced automatic target recognit radar automatic target recognition technology and for electro- target recognition technologies. Assessed methods and meas identification approaches using multiple sensor types. Develop for assessing automated exploitation and rapid response syste protection, stability, and security operations. <i>FY 2010 Plans:</i> In FY 2010: Continue to assess the image formation and proc electro-optical/infrared/hyper-spectral imagery data from resea taking advantage of disparate phenomenology to improve auto classification and identification performance. Continue to deve frequency synthetic data generation tools required to augment development, and operational data sets. Search out unexploit initiate development of tools and technology required to exploi tests and assessment of multi-sensor and sensor fusion algori weapon delivery systems. Continue enhancements to databas as required to support assessment and validation of models ar to improve automatic target recognition performance evaluatio technologies. Continue to develop assessment methods and r identification approaches using multiple sensor types. Continu measures for assessing automated exploitation and rapid resp force protection, stability, and security operations.	at of tools and technology supporting in exploited. Conducted laboratory thms for automated exploitation and ition performance evaluation theory for optical and multiple-sensor automatic sures for moving target tracking and ped analysis methods and measures ems proposed for post-conflict force easing of synthetic aperture radar, arch and development data collections omatic target recognition detection, elop and validate multi-sensor/multi- and enhance collected research, ed phenomenological features and t said features. Continue laboratory thms for automated exploitation and ses, tools and laboratory environments and exploitation technologies. Continue in theory for automatic target recognition measures for moving target tracking and ue development of analysis methods and							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 626095: Se	ECT 5: Sensor Fusion Technology				
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Complete initial assessment of image formation a radar, electro-optical/infrared/hyper-spectral imagery data from collections taking advantage of disparate phenomenology to in detection, classification and identification performance. Contin validation of multi-sensor/multi-frequency synthetic data general enhance collected research, development, and operational dat phenomenological features and continue development of tools features. Continue laboratory tests and assessment of multi-set for automated exploitation and weapon delivery systems. Contools and laboratory environments as required to support assest exploitation technologies. Continue to improve automatic target theory for automatic target recognition technologies. Continue and measures for moving target tracking and identification app Complete initial development of analysis methods and measure and rapid response systems proposed for post-conflict force properations.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A.</li> </ul>	a research and development data prove automatic target recognition ue to develop and perform initial ation tools required to augment and a sets. Search out unexploited and technology required to exploit said ensor and sensor fusion algorithms tinue enhancements to databases, ssment and validation of models and et recognition performance evaluation to develop assessment methods roaches using multiple sensor types. es for assessing automated exploitation							
MAJOR THRUST: Develop, evaluate, and demonstrate target sign fusion algorithm development and testing for reconnaissance and s		3.427	4.817	6.250	0.000	6.25		
FY 2009 Accomplishments: In FY 2009: Matured target signature models for signature exp electro-optical multi-spectral systems, and signals intelligence algorithms, and modeling support for multiple radio-frequency a	sensors. Developed signatures,							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 6600: Research, Development, Test & Evaluation, Air Force 8A 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 626095: <i>Se</i>	nsor Fusion	Technology	
3. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 201 Total
automatic target recognition of tactical ground targets. Initiate algorithms, target modeling, and phenomenological modeling that heretofore have not been exploited. Generated synthetic with sufficient fidelity to support automatic recognition of targe environments. Demonstrated a synthetic scene data generatia and developed an electro-optical scene capability applicable to Investigated model-driven spectral signal processing and expl automatic target recognition algorithm-driven radio-frequency for existing sensors, and signal processing/exploitation for high <i>FY 2010 Plans:</i> In FY 2010 Plans: In FY 2010: Continue to mature target signature models for si sensors, electro-optical multi-spectral systems, and signals int target model for application to all parts of the spectrum. Conti and modeling support for multiple radio-frequency and electro- recognition of ground targets. Continue search for and the de target modeling and phenomenological modeling of other phen have not been exploited. Continue to generate synthetic air ar sufficient fidelity to support development and assessment of a operationally realistic mission environments. Continue demon coverage, synthetic scene data generation capability for radio- Continue investigation of model-driven spectral signal process Continue development of automatic target recognition algorith new modes of operation for existing sensors, and signal process <i>FY 2011 Base Plans:</i> In FY 2011: Complete initial target signature models for signa sensors, electro-optical multi-spectral systems, and signals int	of other phenomenological features air and ground target signatures ts in operationally realistic mission on capability for radio-frequency scenes o large area reconnaissance coverage. oitation techniques. Developed sensor design, new modes of operation n-diversity data. gnature exploitation of radio-frequency elligence sensors emphasizing one nue to develop signatures, algorithms, optical phenomenology automatic target velopment of signatures that heretofore ad ground target signatures with utomatic recognition of targets in stration of large area, reconnaissance frequency and electro-optical sensors. ing and exploitation for high-diversity data. ture exploitation of radio-frequency					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 626095: Se	nsor Fusion	Technology	
B. Accomplishments/Planned Program (\$ in Millions)	-		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>target model for application to all parts of the spectrum. Continue and modeling support for multiple radio-frequency and electro-optic recognition of ground targets. Continue the development of signat and phenomenological modeling of other phenomenological featur Continue to generate synthetic air and ground target signatures wirdevelopment and assessment of automatic recognition of targets in environments. Continue development of automatic target recognition sensor design, new modes of operation for existing sensors, and s for high-diversity data. Initiate measurements and prediction technic signatures in support of space situational awareness.</li> <li><i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.</li> </ul>	cal phenomenology automatic target ures, algorithms, target modeling, es not previously exploited. th sufficient fidelity to support n operationally realistic mission nal processing and exploitation algorithm-driven radio-frequency ignal processing/exploitation					
<ul> <li>MAJOR THRUST: Develop ATR, sensor management, and sensor fust tracking, and identification in ISR and combat identification applications</li> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Completed initial fusion capability for radar, electro-op and ranging, and hyperspectral features for target detection, tracki management techniques. Evaluated and improved physics-based identification for intelligence, surveillance, and reconnaissance and Developed and initiated evaluation of automated battle space behat technology that will capitalize on precision time, position, attitude, a improved geo-location capabilities for future distributed time and di its inclusion into fusion functions. Completed and evaluated multitechniques. Developed capabilities to represent and utilize sensor with other uncertainty reference information, for improved fused geo-</li> </ul>	s. btical/infrared, laser detection ng, and identification with sensor techniques for target detection and d combat identification applications. avior analysis. Developed and velocity sensor data to enable istributed platform sensing; initiated sensor, pixel level registration parameters and errors, along	5.058	1.932	2.290	0.000	2.290

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 626095: Se	<b>DJECT</b> 095: Sensor Fusion Technology				
3. Accomplishments/Planned Program (\$ in Millions)	1		1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 201 Total		
bio-inspired automatic target recognition for robustness and in for urban applications. Evaluated automatic target recognition fusion research for urban intelligence, surveillance, and recon vehicles.	n, sensor management, and sensor							
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Demonstrate and assess fusion capability for rad detection and ranging, and hyperspectral features for target desensor management techniques. Enhance physics-based tech identification requirements for intelligence, surveillance, and reapplications. Continue development and evaluation of automa Continue development and assessment of technology that will and velocity sensor data to enable improved geo-location capadistributed platform sensing. Enhance multi-sensor, pixel lever to support requirements. Continue to assess and develop cap parameters and errors, along with other uncertainty reference location accuracy. Continue research of bio-inspired automatia and continue to assess and evaluate these techniques for all r applications. Evaluate automatic target recognition, sensor m for urban intelligence, surveillance, and reconnaissance from set of urban intelligence and assess physics-based techniques to identification requirements for intelligence, surveillance, and reconnaissance from set of urban intelligence and assess physics-based techniques to identification requirements for intelligence, surveillance, and reconnaissance from set of urban intelligence and assess physics-based techniques to identification requirements for intelligence, surveillance, and reconnaissance for the identification requirements for intelligence.</li> </ul>	etection, tracking, and identification with hniques to meet the target detection and econnaissance and combat identification ated battle space behavior analysis. I fuse precision time, position, attitude, abilities for future distributed time and el registration techniques as necessary babilities to represent and utilize sensor information, for improved fused geo- ic target recognition technologies missions with emphasis on urban anagement, and sensor fusion research small unmanned aerial vehicles.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		PROJECT 626095: Se	ensor Fusion		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
development and assessment of technology that will fuse prec sensor data to enable improved geo-location capabilities for fu platform sensing. Enhance multi-sensor, pixel level registratio requirements. Continue to assess and develop capabilities to and errors, along with other uncertainty reference information, accuracy. Continue research of bio-inspired automatic target r assess and evaluate these techniques for all missions with em assessment of automatic target recognition, sensor manageme urban intelligence, surveillance, and reconnaissance from sma <i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.	ture distributed time and distributed n techniques as necessary to support represent and utilize sensor parameters for improved fused geo-location recognition technologies and continue to phasis on urban applications. Complete ent, and sensor fusion algorithms for					
<ul> <li>MAJOR THRUST: Develop technical methods required for algorith sensing, layered sensing and other sensing and exploitation technologies. FY 2009 Accomplishments:</li> <li>In FY 2009: Evaluated new innovations in automatic target recognition approach development of an integrated, unified automatic target recognitivarious automatic target recognition subcomponent efforts.</li> <li>FY 2010 Plans:</li> <li>In FY 2010: Continue evaluation of new innovations in automatic target recognitis subcomponents. Begin development of a capability to model to support performance modeling and assessment. Continue of the subcomponent of the support performance modeling and assessment.</li> </ul>	blogies impacted by ATR capabilities. cognition-related technologies. les for subcomponents. Began tion methodology, building upon the atic target recognition-related c target recognition approaches for he performance of these technologies. elop databases and tools required	1.477	1.471	5.638	0.000	5.638

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 626095: Se	ensor Fusion	Technology	
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
unified automatic target recognition methodology building upor developed.	n the modeling and assessment tools					
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Continue investigations of sensor exploitation tec capability to model the performance of these technologies. Ini models. Continue development of databases and tools require assessment. Continue and enhance development of an integr recognition methodology building upon the modeling and asse</li> <li>FY 2011 OCO Plans:</li> </ul>	tiate validation of algorithm performance ed to support performance modeling and ated, unified automatic target					
In FY 2011 OCO: N/A. MAJOR THRUST: Develop, evaluate, and demonstrate methodolo	ngies techniques and strategies to instill	4.420	4.785	2.496	0.000	2.49
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Developed new technologies and methodologies for distributed trusted collaborative heterogeneous sensor syst</li> <li>Developed new techniques for system of systems sensor engi techniques for sensor network situational awareness and pred self-organizing collaborative sensor systems for multi-layered self-organizing collaborative critical areas and technologies nee networks.</li> </ul>	ce, and cyber domains. for defining adaptive architectures tems and semantic sensor networks. neering and analysis. Developed new ictive analytics to optimize object driven, sensing. Initiated research into sensor					2.10
FY 2010 Plans: In FY 2010: Complete development of new techniques for sys Complete development of new techniques for sensor network measures of trust for multi-layered sensing. Complete develop	situational awareness and global					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 626095: Sensor Fusion Te			Technology	
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>system trustworthiness for collaborative and distributed heterog and semantic sensor networks. Continue development of new producing adaptive, trusted architectures for multi-layered sense</li> <li><i>FY 2011 Base Plans:</i> In FY 2011: Complete development of new technologies and r trusted architectures for multi-layered sensing. Initiate develop web services, middleware, and frameworks for multi-layered se development of methodologies and techniques for visualization Initiate development of technologies for assessing, evaluating, distributed heterogeneous sensor systems.</li> <li><i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.</li> </ul>	technologies and methodologies for sing. nethodologies for producing adaptive, ment of advanced trusted sensor ensing and cyber sensing. Initiate and portrayal of a global trust picture.						
<ul> <li>MAJOR THRUST: Develop technologies that enable autonomic traverse engineering and exploitation of critical military hardware an <i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.</li> <li><i>FY 2010 Plans:</i> In FY 2010: Develop and demonstrate critical technologies for sensing systems to assure anti-tamper and software protection and evaluate commercial technologies for application to militar demonstrate secure cyber sensing station for ISR and cybersp of autonomic trusted sensor technologies to address self-ware sensor systems.</li> </ul>	d software systems. trusted sensors for multi-layered ISR of key military capabilities. Assess y trusted systems. Develop and ace applications. Initiate development	0.000	1.098	1.429	0.000	1.429	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 626095: Se	<b>T</b> Sensor Fusion Technology		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans: In FY 2011: Continue to develop key technologies for trusted s systems to assure anti-tamper and software protection of key m assess and evaluate commercial technologies for application to development of autonomic trusted sensor technologies to addre organizing sensor systems. Initiate development of integrated a solutions. Initiate development of key technology experiments t technologies on military weapon systems.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A.</li> </ul>	nilitary capabilities. Continue to military trusted systems. Continue ess self-ware, self-healing, and self- anti-tamper and software protection					
MAJOR THRUST: Develop secure backplane, integration technology, physical topologies, and protocol- support multi-layered sensing and trusted sensor networks for air, space, and cyber domains. <i>FY 2009 Accomplishments:</i> In FY 2009: Initiated development of conceptual design of sensor web backbone technology to			2.242	1.644	0.000	1.644
assure trusted sensor interactions for multi-layered persistent IS infrastructure and components. Initiated development of senso to assess and evaluate critical sensor data link technologies an networks.	r web backbone integration laboratory					
FY 2010 Plans: In FY 2010: Complete conceptual design conceptual design of assure trusted sensor interactions for multi-layered persistent IS of sensor web backbone integration laboratory. Complete initia technologies for trusted sensing. Initiate development of advan trusted sensing. Initiate analysis to exploit wired and wireless s	SR sensing. Continue development I assessment of available sensor loced sensor bus technologies for					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 626095: Sensor Fusion Technolog			
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Continue demonstration of laboratory prototype of topologies. Continue development of advanced sensor bus tect Continue analysis to exploit wired and wireless senor web system to defend sensor web systems. Complete development of the sensor web</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: N/A.</li> </ul>	hnologies for trusted sensing. ems and begin analysis of technologies					
Accom	nplishments/Planned Programs Subtotals	18.005	18.355	27.008	0.000	27.008
	ſ			1		
		FY 2009	FY 2010	-		
Congressional Add: Sensor Fusion. FY 2009 Accomplishments:		2.394	0.000			
In FY 2009: Conducted Congressionally-directed effort for Sen	sor Fusion.					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
Congressional Add: Advanced Data Exploitation and Visualization.		0.798	0.000			
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Adv Visualization.	anced Data Exploitation and					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensor</i>	S	PROJECT 626095: Se	ensor Fusion Technolog
B. Accomplishments/Planned Program (\$ in Millions)				
		FY 2009	FY 2010	]
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
		1.596	1.434	-
Congressional Add: Information Quality Tools for Persistent Surve	illance Data Sets.			
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Info Surveillance Data Sets.	ormation Quality Tools for Persistent			
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Inform Surveillance Data Sets.	nation Quality Tools for Persistent			
		0.798	2.390	-
Congressional Add: Net-Centric Sensor Grids.				
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Net	t-Centric Sensor Grids.			
FY 2010 Plans:				
In FY 2010: Conduct Congressionally-directed effort for net-ce				4
Congressional Add: Persistent Sensing Data Processing, Storage	and Retrieval.	1.596	0.000	
FY 2009 Accomplishments:				
In FY 2009: Conducted Congressionally-directed effort for Per Storage and Retrieval.	rsistent Sensing Data Processing,			

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVI</b> 3600: Research, Development, Test BA 2: Applied Research		a, Air Force		<b>R-1 ITEM NO</b> PE 0602204	-	-		<b>PROJECT</b> 626095: Se	ensor Fusion	Technology	
B. Accomplishments/Planned Prog	gram (\$ in N	lillions)						1			
							FY 2009	FY 2010	]		
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
				Congre	essional Add	s Subtotals	7.182	3.824	-		
C. Other Program Funding Summa	arv (\$ in Mill	ions)							_		
<u> </u>		<u></u>	FY 2011	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	<u>FY 2010</u>	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>		Total Cost
• PE Not Provided (9846): <i>Activity</i> <i>Not Provided</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602500F: <i>Multi-Disciplinary</i> Space Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603203F: Advanced Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602602F: Conventional Munitions.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603270F: Electronic Combat Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603226E: Experimental Evaluation of Major Innovative Technologies.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
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, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>			<b>PROJECT</b> 627622: <i>RF</i>	- Sensors &	Countermea	sures Tech				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
627622: RF Sensors & Countermeasures Tech	24.804	35.923	55.696	0.000	55.696	39.953	40.260	36.554	37.130	Continuing	Continuing

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop technology to reduce size, weight, and power of RF sensors. Develop technology to enable affordable upgrades and optimally control RF and multi-intelligence sensors.	7.668	5.380	4.588	0.000	4.588
FY 2009 Accomplishments: In FY 2009: Demonstrated integration of an electronic warfare and surveillance suite in a size, weight, and power constrained environment. Developed and evaluated advanced mode control concepts to					

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		DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 627622: <i>RF</i>	Sensors & (	Countermea	sures Tech
B. Accomplishments/Planned Program (\$ in Millions)		1				
	FY	2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>provide concurrent radio-frequency sensors and electronic was a single platform. Defined approaches allowing the simultane and their back-end exploitation functions. Developed advance concepts/techniques for spatial and temporal adaptivity to over parameterization in complex environments. Developed and e receiver/exciter technologies for electronic support, electronic and passive multi-mode sensor applications. Conducted digit analysis for electronic warfare scenarios in modern signal environments.</li> <li>FY 2010 Plans:</li> <li>In FY 2010: Continue demonstration of advanced RF receiver techniques generators technologies. Initiate new effort for the ES and/or EA capability.</li> </ul>	ous design and development of sensors ed electronic support digital receiver rcome limitations to precision emitter valuated advanced adaptive digital protection, electronic attack, and active al receiver simulation, modeling, and ironments. Refined reductions in size, severely constrained unmanned air					
FY 2011 Base Plans: In FY 2011: Continue the research and exploration of an ada exploration of the synergy of real-time ES coupled with tailora						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
	ce electronic aperture technologies and	4.845	4.879	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 627622: <i>RF</i>	= Sensors &	Countermea	sures Tech
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Complete design and development of multi-function th receiver and exciter.	nin-profile array with integrated					
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop RF sensing and electronic warfare/informatechnologies for concurrent multi-mode operation and digital beam form		2.978	2.784	17.960	0.000	17.960
FY 2009 Accomplishments: In FY 2009: Demonstrated autonomous constellations of active ar sensor techniques for close-in sensing and electronic warfare/infor using distant sources of opportunity. Demonstrated and tested mu digital beam forming.	mation operations applications					
FY 2010 Plans: In FY 2010: Design and develop highly digital electronically scann capabilities for multi-mode radio frequency sensing. Develop integ beamforming concepts to support wideband multi-INT sensing sys simulation capability, critical components, algorithms, and subsyste	rated receiver/exciter and digital tems including modeling and					
FY 2011 Base Plans: In FY 2011: Continue development of highly digital electronically s an integrated receiver, exciter and digital beamforming subsystem sensing systems. Characterize and assess emerging over-the-hor	to support wideband multi-INT					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 627622: <i>RF</i>	<b>T</b> RF Sensors & Countermeasures Tech			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
using modeling and simulation, experimentation, and demons development needed to advance the state-of-the-art in OTH r	•						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop waveforms using transmit adaptivity and multi-mode operation, and multi- platform, multi-mission sensor and EW adaptive processing algorithms to improve sensor performance.		7.717	14.636	25.376	0.000	25.376	
FY 2009 Accomplishments: In FY 2009: Initiated and conducted experiments to demonstr improvements of adaptive transmit waveforms, new distribute distributed sensing and electronic warfare/information operation mode, and shared aperture applications.	d signal processing techniques, and						
FY 2010 Plans: In FY 2010: Investigate and evaluate waveform diversity tech output adaptive processing algorithms to improve electronic p and advanced radio-frequency systems. Continue developme techniques to obtain high spatial resolution with limited transm targets such as those with low radar cross-section.	rotection functions in conventional ent of distributed signal processing						
FY 2011 Base Plans: In FY 2011: Develop new electronic protection techniques ex and multiple-input/multiple-output adaptive processing algorith approaches to the employment of distributed signal processin resolution with limited transmit bandwidth, and to detect challe radar cross-section.	nms. Develop operationally relevant g techniques to obtain high spatial						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: Aerospace Sensors		<b>PROJECT</b> 627622: <i>RF</i>	PROJECT 627622: RF Sensors & Countermeasu			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop hybrid space-based sensor solutions t detect difficult targets. Develop jam-resistant space-qualified time, <i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.		0.000	5.243	4.633	0.000	4.633	
FY 2010 Plans: In FY 2010: Investigate optimal means of tightly coupling network reference systems by leveraging onboard sensors observation the distributed, multi-platform reference. Conduct ground-base building blocks compatible with operationally responsive space	is as feedback to robustly calibrate ed demonstration of modular payload						
FY 2011 Base Plans: In FY 2011: Continue to investigate optimal means of tightly c with their reference systems by leveraging onboard sensor obs calibrate the distributed, multi-platform reference. Demonstrate technology both non-real-time and real time.	servations as feedback to robustly						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Study adaptive processing techniques for large arrays to meet the demands of wide area sensing in severe clutter		0.000	1.725	0.821	0.000	0.821	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 627622: <i>RI</i>	PROJECT 627622: RF Sensors & Countermeasu			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2010 Plans: In FY 2010: Evaluate advanced surface moving target indicati architectures for high altitude, environmentally constrained rad applications. Evaluate emissions mapping and bistatic radar to awareness.	io frequency sensing system						
FY 2011 Base Plans: In FY 2011: Demonstrate an integrated radio frequency and e toolset for an advanced space situational awareness architectu techniques for space-based sensors, exploiting waveform dive multiple-output adaptive processing algorithms.	ure. Develop electronic protection (EP)						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop multi-band and multi-beam forming tec antenna array operations in dynamic sensor networks.	hnologies. Address technologies for	0.000	0.160	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
<i>FY 2010 Plans:</i> In FY 2010: Demonstrate a responsive space payload.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>		<b>PROJECT</b> 627622: <i>RF</i>	- Sensors & (	Countermea	sures Tech
B. Accomplishments/Planned Program (\$ in Millions)			I			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop sensor techniques to achieve highly a performance for hypersonic air vehicles in prompt global strike app		0.000	1.116	2.318	0.000	2.318
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Design a radio-frequency hardware-in-the-loop tervehicle plasma characteristics, platform trajectories, and highly techniques for space-based applications. Demonstrate a constassess hypersonic navigation techniques in terms of measures	y accurate and robust navigation structive systems engineering model to					
FY 2011 Base Plans: In FY 2011: Complete the design of a radio-frequency hardware hypersonic air vehicle plasma characteristics, platform trajectore navigation techniques for space-based applications. Continue engineering model to assess hypersonic navigation techniques and warfighter utility.	ories, and highly accurate and robust to demonstrate a constructive systems					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
Ассо	mplishments/Planned Programs Subtotals	23.208	35.923	55.696	0.000	55.696
	[	FY 2009	FY 2010	]		
		1.596		-		
Congressional Add: Weather Sensors for Cursor On Target.			0.000			

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 2: Applied Research		, Air Force		<b>R-1 ITEM N</b> PE 0602204				<b>PROJECT</b> 627622: <i>RF</i>	Sensors &	Countermea	sures Tech
B. Accomplishments/Planned Pro	gram (\$ in M	lillions)						1			
		-					FY 2009	FY 2010			
FY 2009 Accomplishments: In FY 2009: Conducted Congre FY 2010 Plans:	essionally-dire	ected effort f	or Weather	Sensors for (	Cursor On T	arget.					
In FY 2010: Not Applicable.											
				Congre	essional Add	s Subtotals	1.596	0.000			
C. Other Program Funding Summa	ary (\$ in Mill	ions)	EV 0044								
Line Item	FY 2009	FY 2010	<u>FY 2011</u> Base	<u>FY 2011</u> OCO	<u>FY 2011</u> Total	FY 2012	FY 2013	FY 2014	EV 2015	<u>Cost To</u> Complete	Total Cos
• PE Not Provided (10219):	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.000
Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602500F: <i>Multi-Disciplinary</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Space Technology.											
• PE 0603203F: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Aerospace Sensors.											
• PE 0603253F: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Avionics Integration.											
• PE 0602782A: Command,	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Control, Communications											
Technology.	0.000		0 000	0.000			0.000				0.00
• PE 0602232N: Navy C3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology.											
D. Acquisition Strategy											
Not Applicable.											

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602204F: <i>Aerospace Sensors</i>	<b>PROJECT</b> 627622: <i>RF</i>	- Sensors & Countermeasures Tech

#### **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, RDT&E Budget Item	Justification	: PB 2011 A	ir Force						DATE: February 2010			
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 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
Total Program Element	136.072	119.125	111.857	0.000	111.857	117.238	117.382	122.143	128.614	Continuing	Continuing	
621010: Space Survivability & Surveillance	48.855	52.983	48.216	0.000	48.216	46.479	43.864	44.915	45.815	Continuing	Continuing	
624846: Spacecraft Payload Technologies	26.837	15.797	20.299	0.000	20.299	20.251	19.990	20.188	18.343	Continuing	Continuing	
625018: Spacecraft Protection Technology	6.687	7.992	7.556	0.000	7.556	9.006	13.287	13.338	13.156	Continuing	Continuing	
628809: Spacecraft Vehicle Technologies	53.693	42.353	35.786	0.000	35.786	41.502	40.241	43.702	51.300	Continuing	Continuing	

#### 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.

ibit R-2, RDT&E Budget Item Justification: PB 2011 Air F	orce			DATE:	February 2010	)
PROPRIATION/BUDGET ACTIVITY 0: Research, Development, Test & Evaluation, Air Force 2: Applied Research		EM NOMENCLA 02601F: Space				
Program Change Summary (\$ in Millions)						
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011	
Previous President's Budget	138.980	104.148	0.000	0.000		0.000
Current President's Budget	136.072	119.125	111.857	0.000		1.857
Total Adjustments	-2.908	14.977	111.857	0.000	11	1.857
<ul> <li>Congressional General Reductions</li> </ul>		0.000				
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000				
Congressional Rescissions	0.000	-0.503				
Congressional Adds		15.480				
Congressional Directed Transfers		0.000				
Reprogrammings	0.000	0.000				
SBIR/STTR Transfer	0.000	0.000				
Other Adjustments	-2.908	0.000	111.857	0.000	11	1.857
Congressional Add Details (\$ in Millions, and Include	es General Redu	uctions)			FY 2009	FY 2010
Project: 621010: Space Survivability & Surveillance						
Congressional Add: Nuclear Test Seismic Research	/AFRL Seismic H	Research Progra	m.		1.995	4.97
		Cong	ressional Add Subtotals	s for Project: 621010	1.995	4.97
Project: 624846: Spacecraft Payload Technologies				-		
Congressional Add: Field Programmable Gate Array	/s/ Field Progran	nmable Gate Arra	ays Mission Assurance	Center.	2.992	0.00
Congressional Add: Radiation Hardened Non-Volati	le Memory Techi	nology.			1.596	0.00
Congressional Add: Reconfigurable Electronic and I	Non-Volatile Men	nory Research.			1.995	0.79
		Cong	ressional Add Subtotals	s for Project: 624846	6.583	0.79
Project: 625018: Spacecraft Protection Technology				-		
Congressional Add: Defensive Counterspace Testbe	ed.			=	0.798	0.00
6 ,						

xhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	e D	ATE: February 2010	)
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: Space Technology		
Congressional Add Details (\$ in Millions, and Includes G	eneral Reductions)	FY 2009	FY 2010
	Congressional Add Subtotals for Project: 625	018	
Project: 628809: Spacecraft Vehicle Technologies			
Congressional Add: Multicontinuum Technology for Space	e Structures.	2.872	0.00
Congressional Add: Shielding Rocket Payloads.		0.399	0.00
Congressional Add: Center for Responsive Space Syste	ms.	0.798	0.00
Congressional Add: Lightweight, High-Efficiency Solar C	ells for Spacecraft.	0.798	0.00
Congressional Add: Massively Parallel Optical Interconn	ects for MicroSatellite Applications.	1.596	0.00
Congressional Add: Center for Solar Electricity and Hydr	ogen.	3.590	3.98
Congressional Add: Advanced Modular Avionics for Ope Operationally Responsive Satellite Use.	rationally Responsive Space Use/Advanced Modular Avionics for	2.394	2.47
Congressional Add: Center for Space Entrepreneurship.		0.000	1.59
Congressional Add: Mission Design and Analysis Tool.		0.000	1.59
	Congressional Add Subtotals for Project: 628	809 12.447	9.63
	Congressional Add Totals for all Proj	ects 21.823	15.41

#### **Change Summary Explanation**

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

Note: In FY 2010, Congress added \$2.48 million for Advanced Modular Avionics for Operationally Responsive Satellite Use, \$4.0 million for the Center for Solar Electricity and Hydrogen, \$1.6 million for the Center for Space Entrepreneurship, \$1.6 million for Mission Design and Analysis Tool, \$5.0 million for AFRL Seismic Research Program, and \$0.8 million for Reconfigurable Electronics and Non-Volatile Memory Research.

C. Performance Metrics.(U) Under Development.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010				
APPROPRIATION/BUDGET ACT 3600: Research, Development, Tes BA 2: Applied Research		n, Air Force		R-1 ITEM NOMENCLATUREPROJECTPE 0602601F: Space Technology621010: Space S				ace Surviva	urvivability & Surveillance			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
621010: Space Survivability & Surveillance	48.855	52.983	48.216	0.000	48.216	46.479	43.864	44.915	45.815	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop technologies for specifying, monitoring, predicting, and controlling space environmental conditions hazardous to Department of Defense (DoD) operational space systems.	8.767	8.079	8.800	0.000	8.800
FY 2009 Accomplishments: In FY 2009: Provided scientific and technical support for both optical and radio parts of solar environmental observing network replacement program. Explored techniques for measuring coronal and interplanetary magnetic fields using new wide-field radio arrays. Tested and evaluated empirical flare prediction models based on synoptic data from Air Force and national observatory assets. Coupled radiation belt model to global geospace environment models to increase accuracy and lead time. Utilized three-dimensional global radiation belt diffusion models to simulate global effect of wave-particle interactions from very low frequency (VLF) electromagnetic wave power injected in narrow altitude slices of radiation belts. Validated models for virtual VLF electromagnetic wave generation in the ionosphere and global transport and power distribution.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: Space Technology		<b>PROJECT</b> 621010: <i>Sp</i>	ace Surviva	ability & Surveillance		
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Complete trade studies for measuring coronal and new wide-field radio arrays. Assimilate solar vector magnetic field radio arrays. Assimilate solar vector magnetic field radio arrays. Assimilate solar vector magnetic field radio arrays. Analyze energetic particle measures to understand the dynamics of the radiation belts and improve specification and forecast models. Begin investigation of new mitigation of hazards due to spacecraft electrostatic charging a radar profile simulation by collecting data from re-entry vehicle simulation upgrade by validating code with flight data.</li> </ul>	field data into solar wind forecast nodels and start development of physics- urements by recently launched sensors accuracy of space environment technologies for simulation and and discharging. Develop the reentry						
FY 2011 Base Plans: In FY 2011: Develop improved solar energetic particle models to physics-based flare forecast models. Complete validation of in multiple orbital regimes. Incorporate new simulation techno electromagnetic and plasma environment. Validate reentry rad Complete plasma effects simulation with upgraded solvers, hig and streamlined user interface.	f energetic particle measurements logies into model of spacecraft dar profile simulation using flight data.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
<ul> <li>MAJOR THRUST: Develop spectral signature libraries, target deterapplication to space-based sensors and surveillance systems.</li> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Finalized brassboard hypertemporal (HT) sensor detection. Incorporated latest real-time HT processing algorith brassboard sensor and algorithms to customer for space-based</li> </ul>	for space-based missile launch ms into sensor platform. Transitioned	14.291	15.145	12.854	0.000	12.854	

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: Space Technology		<b>PROJECT</b> 621010: <i>Sp</i>	<b>CT</b> : Space Survivability & Surveillanc			
B. Accomplishments/Planned Program (\$ in Millions)	1						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
feasibility of HT applications for technical intelligence from group Defined the requirements and configuration of a space-based simulation capability, based on the sensor performance model space operator community in trade space analyses of sensors on the capabilities to derive information and intelligence about and all temporal regimes. Investigated spectral applications for military chemical/biological weapons detection and identification bands. Completed transition of spectral image processing and signature databases to government users. Completed analysis planned space demonstrations of spectral theater surveillance validation of hyperspectral models.	HT sensor. Developed end-to-end s, to assist acquisition community and or sensor suites. The emphasis was space objects with signals in all bands or material identification in support of on in the thermal infrared and other d exploitation algorithms and related s and documentation of military utility of						
FY 2010 Plans: In FY 2010: Demonstrate aircraft-based detection of large boo thick sunlit clouds using existing HT image processing. Start fr model validation and inversion. Initiate the development of set object orbital maneuver based on propulsion signatures. With develop technical specification of space-based multi-phenome (SSA) sensor payload. Document final results from space exp Initiate thermal infrared (IR) imaging spectrometer feasibility for existing spectral radiative transfer models to evaluate requiren imaging spectrometer to meet anticipated mission needs.	ocused effort on thermal atmospheric nsor system to characterize space trade space analyses, downselect and enology Space Situational Awareness periments in reflective spectral tests. or space missions. Employ and refine						
FY 2011 Base Plans: In FY 2011: Prepare to demonstrate space-based detection of optically thick sunlit clouds using existing satellite asset and H critical test of maneuver characterization sensor system with g development of multi-phenomenology SSA sensor system for	T imaging processing. Conduct o-no-go decision point. Initiate the						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010					
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>		<b>PROJECT</b> 621010: <i>Sp</i>	ace Survivability & Surveillance				
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>thermal IR imaging spectrometer feasibility for space missions. Build and validate robust spectral radiative transfer models to evaluate requirements of space based thermal infrared IR imaging spectrometer to meet mission requirements. Continue focused effort on thermal atmospheric model validation and inversion.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>								
In FY 2011 OCO: N/A MAJOR THRUST: Develop AI techniques, forecasting tools, and sensors for ionospheric specification and forecasting, space-based geolocation demonstrations, and determination of radar degradation. <i>FY 2009 Accomplishments:</i> In FY 2009: Investigated solar activity on enhancement of L-band scintillations to assess the support of the scintillation database and tools to military communication and navigation systems. Measured total electron content and scintillations over the African subcontinent for better defining the equatorial scintillation and Global Positioning System (GPS) error environment in the middle-eastern region. Delivered ionospheric compensation technique with wide-band radio-frequency waves. Improved modeling techniques for specifying high temporal resolution of neutral density and satellite drag to achieve predictive SSA. Improved empirical neutral density model based on atmospheric density specification experiment data and developed physics-based neutral modeling including composition, and density. Transitioned physics-based 3-D model of equatorial plasma bubbles into warfighter products and incorporated ionospheric Kalman filter operational models into equatorial models.		7.410	9.598	9.115	0.000	9.115		
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Develop more capable, less costly ground sensors for scintillation parameters utilizing software digital radio technology a Validate Communications/Navigation Outage Forecasting System for operational uses. Implement semi-empirical high-latitude mode to the low latitude ionosphere to improve scintillation forecasts. As</li> </ul>	IND NEWLY AVAILABLE SATELLITE SIGNALS. (C/NOFS) instruments and products el to couple solar storm effects							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: Space Technology		<b>PROJECT</b> 621010: <i>Sp</i>	<b>ROJECT</b> 21010: Space Survivability & Surveillance		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>performance of lower frequency space-radar applications such and coherent-change detection during solar maximum condition coupled models. Document improved methods for tailoring the scattering, etc.) using the High-frequency Active Auroral Reservalidate scintillation and electron density profiles from radio or algorithm development. Expand ground-based sensor networ goals and tactical operations. Begin development of SSA test</li> <li><i>FY 2011 Base Plans:</i> In FY 2011: Deliver validated algorithm to simulate ionospherr waveforms for arbitrary propagation paths to support many appradar for coherent change detection. Improve assimilative ion deficiencies in forecast models. Deliver physics-based equate operations, derived from C/NOFS Advanced Concept Techno based neutral density models forecasting capabilities, particul algorithm for estimating ionospheric-errors on dual-frequency identify appropriate path for integrating into operations. Derive from space-based occultation techniques. Begin deployment support costs of ground-station network.</li> <li><i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A</li> </ul>	ons. Quantify the requirements for e propagation environment (scintillation, arch Program (HAARP) facilities. ccultation techniques for operational k to remote areas supporting research bed. ic effects on wideband radio frequency plications, including impacts on space- ospheric nowcast models and identify orial scintillation forecast code for logy Demonstration. Test physics- arly during magnetic storms. Deliver GPS systems for DoD applications; e algorithm for nowcast scintillation					
MAJOR THRUST: Develop HAARP site transmitting and diagnost	ic instrument infrastructure. Note: In FY	9.703	9.225	11.059	0.000	11.059

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>	F Space Survivability & Surveillance				
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Continued research to characterize wave-particle in effects in space and their potential application to mitigate charge and operations.						
FY 2010 Plans: In FY 2010: Enhance wave-particle interactions and amplification charged particle effects on space systems and operations with of Science Experiment (DSX) satellite studies and feedback from p	coordinated Demonstration and					
FY 2011 Base Plans: In FY 2011: Initiate research programs to develop controlled print infrared emissions and radio scintillation for potential DoD applie Demonstration and Science Experiment satellite and HAARP bat physical models.	cations. Develop experiment using					
FY 2011 OCO Plans: In FY 2011 OCO:  N/A						
MAJOR THRUST: Develop seismic technologies to support national explosions with special focus on regional distances less than 2,000 FY 2009 Accomplishments:		6.689	5.957	6.388	0.000	6.388
In FY 2009: Developed different techniques for automated proc of seismic events. Conducted detailed research on causes of c regional discrimination. Continued efforts on seismic calibration discrimination; and observational studies of seismic wave propa Eurasia. Conducted detailed studies of particular challenge are Conducted design and conducted theoretical, laboratory, and fie	hallenges in high-frequency a; seismic detection, location, and agation, including propagation in as in local seismic monitoring.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: Space Technology		<b>PROJECT</b> 621010: Space Survivability & Surveil				
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2010 Plans: In FY 2010: Refine and expand the applicability of different terrincreasing numbers of seismic events. Continue to conduct dealing high-frequency regional discrimination. Integrate results of a studies of seismic wave propagation, including propagation in to conduct detailed studies of particular challenge areas in local conduct theoretical, laboratory, and field studies to support loc to study improvements in seismic detection, location, and discrete to study improvements. Evaluate causes of challenges in high-frequand refine unified model results of seismic calibration and observer propagation, including propagation in Eurasia. Continue to conduct hallenge areas in local seismic monitoring. Continue to conduct hallenge areas in local seismic monitoring targets. Conduct hallenge areas in local seismic monitoring. The set of seismic monitoring has been been been been been been been bee</li></ul>	etailed research on causes of challenges seismic calibration and observational Eurasia, into a unified model. Continue al seismic monitoring. Continue to al monitoring of new targets. Continue rimination. ated processing of increasing numbers uency regional discrimination. Test ervational studies of seismic wave nduct detailed studies of particular uct theoretical, laboratory, and field						
Ассон	mplishments/Planned Programs Subtotals	46.860	48.004	48.216	0.000	48.216	
	]	FY 2009	FY 2010	1			
		1.995	4.979	1			
Congressional Add: Nuclear Test Seismic Research/AFRL Seismi	c Research Program.						

Exhibit R-2A, RDT&E Project Just	tification: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 2: Applied Research		, Air Force		<b>R-1 ITEM NO</b> PE 0602601	-	-		<b>PROJECT</b> 621010: <i>Spa</i>	ace Surviva	bility & Surve	eillance
B. Accomplishments/Planned Pro	ogram (\$ in M	illions <u>)</u>	1								
							FY 2009	FY 2010			
FY 2009 Accomplishments: In FY 2009: Conducted Congr FY 2010 Plans: In FY 2010: Conduct Congres:											
				Congre	ssional Add	s Subtotals	1.995	4.979			
C. Other Program Funding Summ	ary (\$ in Milli	ons)	FY 2011	FY 2011	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	FY 2009	<u>FY 2010</u>	Base	000	Total	FY 2012	FY 2013	<u>FY 2014</u>	FY 2015	<u>Complete</u>	Total Cost
• PE 0305111F: Weather Systems.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0305160F: <i>Defense</i> <i>Meteorological Satellite Program.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0601102F: Defense Research Sciences.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602204F: Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603401F: Advanced Spacecraft Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

#### 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, RDT&E Project Ju	stification: Pl	3 2011 Air Fo	orce						DATE: Feb	ruary 2010	
					IOMENCLA 1F: Space To			PROJECT 624846: Spacecraft Payload Technolog			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
624846: Spacecraft Payload Technologies	26.837	15.797	20.299	0.000	20.299	20.251	19.990	20.188	18.343	Continuing	Continuing

#### <u>Note</u>

Note: In FY 2011, increases in funding are due the movement of technologies from PE 0603401F, Advanced Spacecraft Technology, to this PE in order to better align the technology readiness levels of these efforts.

#### 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop advanced infrared device technologies that enable hardened space detector arrays with improved detection to perform acquisition, tracking, and discrimination of space objects.	4.961	3.140	4.207	0.000	4.207
FY 2009 Accomplishments: In FY 2009: Investigated spectral agility. Demonstrated tuning from 8 to 12 microns in 1 micron increments. Investigated field enhancement technologies. Demonstrated optical amplification using quantum interference and demonstrated enhancement using plasmons. Investigated the single pixel polarimeter. Demonstrated improved long-wave infrared (LWIR) superlattice detector and assessed very long-wave infrared feasibility.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>		<b>PROJECT</b> 624846: <i>Sp</i>	acecraft Pay	load Techno	ologies
B. Accomplishments/Planned Program (\$ in Millions)	'		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Expand investigation of spectral agility to longer wave field enhancement technologies. Complete final demonstration of o interference.						
<ul> <li>FY 2011 Base Plans: In FY 2011: Demonstrate tuning from 15 to 20 microns in 1 micron field enhancement technology. Complete predictive capability for n technology challenges. Initiate predictive capability for next genera and readout array technology challenges. Begin space object remo FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	next generation of large format ation of large format detector array					
MAJOR THRUST: Develop spectral sensing and data exploitation methods remote sensing applications.	hodologies for military imaging and	2.999	3.807	5.485	0.000	5.485
FY 2009 Accomplishments: In FY 2009: Completed the development and initiated the validation advanced imaging. Validated model against laboratory and availab surveillance, and reconnaissance (ISR) and SSA missions. Made capability to improve accuracy and usability of the model. Utilized concepts for purpose built sensors for SSA.	ble field data of intelligence, improvements to the simulation					
FY 2010 Plans: In FY 2010: Complete validation of advanced imaging technology of operation. Continue to advance simulation capability to enhance models.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	uary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: Space Technology		<b>PROJECT</b> 624846: <i>Sp</i>	<b>T</b> Spacecraft Payload Technologies			
B. Accomplishments/Planned Program (\$ in Millions)	1						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 Base Plans: In FY 2011: Further refine models for space-based spectral image situational awareness imaging concepts and operationally respor							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop technologies for space-based payload co electronic devices, micro-electro-mechanical system devices, and adv	•	4.160	3.392	5.241	0.000	5.241	
FY 2009 Accomplishments: In FY 2009: Completed the current Satellite Design Automation s button toolflow" satellite builder. Demonstrated radiation-harden allocating standardized data message protocols from sensors for actuators.	space sensor interface modules						
<i>FY 2010 Plans:</i> In FY 2010: Initiate study of phase change materials and begin to that enable efficient analog computing. Develop methods of hard devices that enable a factor of two increase in computing perform nanoelectronic devices and incorporate those into new classes of terahertz operation. Initiate the study of thermoelectric cooling bar materials. Initiate development of radiation hardened plug-and-p development or reconfiguration of spacecraft hardware.	lening generation-after-next electronic nance. Investigate the operation of of detectors and transistors to enable ased on advanced Peltier effect						
FY 2011 Base Plans: In FY 2011: Apply the basic physical understanding of the opera analog computing and device trimming applications. Transition ra minimally invasive techniques into libraries at major commercial f	adiation mitigation processes using						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: Space Technology		<b>PROJECT</b> 624846: <i>Sp</i>	ECT 6: Spacecraft Payload Technologie			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
and 65nm nodes. Characterize the reliability and suitability of insulator materials and provide the findings to industry. Apply field effect transistors to commercial foundries. Initiate program thermoelectric cooling devices applied to focal plane arrays. C hardened plug-and-play interface module, including fabrication modules, to support rapid development or reconfiguration of sp <i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A	the understanding of quantum based n to capitalize on high performance continue development of radiation of engineering model interface						
MAJOR THRUST: M&S tools for space-based ground surveillance operations, imaging of space systems, distributed satellite architect <i>FY 2009 Accomplishments:</i> In FY 2009: Developed engineering, military utility, and cost m SSA detection capabilities. Developed a simulation repository simulation lab. Developed first-generation decision support too	ure, and space control payloads. nodels for space superiority analysis of capability for the distributed architecture ols for space superiority. Developed	4.622	4.191	4.481	0.000	4.48	
<ul> <li>confidence metrics and software system testbed to score deve</li> <li>FY 2010 Plans:</li> <li>In FY 2010: Complete SSA detection analysis tools and begin utility models for object identification to support SSA and defer additional tools from external and external sources. Validate to repository. Continue development of first-generation decision Finalize software system testbed. Begin testing of tools on test management tools for space superiority.</li> </ul>	developing engineering and military sive space control (DSC). Incorporate bols and code in the simulation support tools for space superiority.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	uary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: Space Technology		<b>PROJECT</b> 624846: <i>Sp</i>	PROJECT 624846: Spacecraft Payload Technolog				
B. Accomplishments/Planned Program (\$ in Millions)	1		1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
FY 2011 Base Plans: In FY 2011: Refine detection and identification tools for model development of engineering, military utility, and cost tools that superiority analysis of SSA and DSC technologies. Integrate of simulations. Finish development of first-generation decision su Expand testbed to include resource management testing capa resource management tools for space superiority.	model object characterization for space data from flight experiments to refine upport tools for space superiority.							
FY 2011 OCO Plans: In FY 2011 OCO: N/A								
MAJOR THRUST: Develop technologies for next-generation space equipment and methods/techniques to enable future space system concepts.		3.512	0.470	0.885	0.000	0.88		
FY 2009 Accomplishments: In FY 2009: Performed study of future communication require testing and performance enhancements experiments.	ments. Developed subsystems for							
FY 2010 Plans: In FY 2010: Begin development of engineering model of critica and ground terminals.	al technology to satellite communication							
FY 2011 Base Plans: In FY 2011: Complete engineering model and select technolo communication platform.	gy for space experiment on enhanced							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A								

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: Space Technology		<b>PROJECT</b> 624846: <i>Sp</i>	bacecraft Pay	load Techno	logies
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Acco	mplishments/Planned Programs Subtotals	20.254	15.000	20.299	0.000	20.299
		FY 2009	FY 2010	]		
Congressional Add: Field Programmable Gate Arrays/ Field Progr Center. <i>FY 2009 Accomplishments:</i> In FY 2009: Conducted Congressionally-directed effort for Field Assurance Center.		2.992	0.000			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
Congressional Add: Radiation Hardened Non-Volatile Memory Te FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Ra Technology.		1.596	0.000			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
				1		

Exhibit R-2A, RDT&E Project Ju	istification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACT 3600: Research, Development, To BA 2: Applied Research		, Air Force		<b>R-1 ITEM N</b> ( PE 0602601				<b>PROJECT</b> 624846: Sp	acecraft Pa	yload Techno	ologies
B. Accomplishments/Planned F	Program (\$ in M	illions)						1			
							FY 2009	FY 2010	]		
<ul> <li>FY 2009 Accomplishments: In FY 2009: Conducted Con Memory Research.</li> <li>FY 2010 Plans: In FY 2010: Conduct Congree Memory Research.</li> </ul>			-								
				Congre	ssional Add	s Subtotals	6.583	0.797	-		
C. Other Program Funding Sum			<u>FY 2011</u>	FY 2011	<u>FY 2011</u>	514 00 40				Cost To	
• PE 0603401F: Advanced	<u>FY 2009</u> 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	<u>OCO</u> 0.000	<u>Total</u> 0.000	<u>FY 2012</u> 0.000	FY 2013 0.000	FY 2014 0.000	<u>FY 2015</u> 0.000	Complete 0.000	<u>Total Cos</u> 0.00
Spacecraft Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
<b>D. Acquisition Strategy</b> Not Applicable.											
E. Performance Metrics Please refer to the Performance Force performance goals and m					Air Force re	esources are	e applied an	d how those	resources a	are contributi	ng to Air

Exhibit R-2A, RDT&E Project Ju	stification: Pl	3 2011 Air F	orce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACT</b> 3600: Research, Development, Te BA 2: Applied Research		n, Air Force			IOMENCLA 1F: Space T			<b>PROJECT</b> 625018: Sp	bacecraft Pro	tection Tech	nology
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
625018: Spacecraft Protection Technology	6.687	7.992	7.556	0.000	7.556	9.006	13.287	13.338	13.156	Continuing	Continuin
B. Accomplishments/Planned P	rogram (\$ in I	<u>Millions)</u>						=>> ==> =====	FY 2011	FY 2011	
							FY 2009	FY 2010	Base	000	FY 2011 Total
MAJOR THRUST: Develop satel board inherent satellite resources						xploit on-	5.889	7.992	7.556	0.000	7.55
FY 2009 Accomplishments: In FY 2009: Developed an a or co-orbital vehicle and trans options that could provide de orbit satellites and completed	sitioned these fensive capab	engineering ility for incor	designs. Id	entified poter	ntial technol	ogy					
FY 2010 Plans: In FY 2010: Explore capabili likely transition opportunities techniques to exploit existing	and prepare e	ngineering n	nodels to as								
FY 2011 Base Plans: In FY 2011: Complete labora goals using engineering mod											

Exhibit R-2A, RDT&E Project Justif	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVI</b> 3600: Research, Development, Test of BA 2: Applied Research		, Air Force		<b>R-1 ITEM N</b> PE 0602601				<b>PROJECT</b> 625018: <i>Sp</i>	nology		
B. Accomplishments/Planned Prog	gram (\$ in M	illions)									
		-					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
systems. Identify emerging opp users.	ortunities to	develop/exp	and defensi	ve subsyster	ns for additio	onal					
FY 2011 OCO Plans: In FY 2011 OCO:  N/A											
			Accomplish	ments/Plann	ed Program	s Subtotals	5.889	7.992	7.556	0.000	7.556
							FY 2009	FY 2010			
							0.798				
Congressional Add: Defensive Cour	nterspace Te	stbed.					0.700	0.000			
FY 2009 Accomplishments: In FY 2009: Conducted Congre	ssionally-dire	ected effort f	or Defensive	e Counterspa	ace Testbed						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
				Congre	ssional Add	s Subtotals	0.798	0.000			
C. Other Program Funding Summa	rv (\$ in Milli	ions)									
			FY 2011	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	FY 2010	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	FY 2015		Total Cost
• PE 0603401F: Advanced Spacecraft Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>D. Acquisition Strategy</b> Not Applicable.											

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
	 <b>PROJECT</b> 625018: <i>Sp</i>	pacecraft Protection Technology

#### **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, RDT&E Project Justification: PB 2011 Air Force										DATE: February 2010			
<b>APPROPRIATION/BUDGET ACT</b> 3600: <i>Research, Development, To</i> BA 2: <i>Applied Research</i>						EM NOMENCLATURE D2601F: Space Technology				<b>PROJECT</b> 628809: Spacecraft Vehicle Technologies			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost		
628809: Spacecraft Vehicle Technologies	53.693	42.353	35.786	0.000	35.786	41.502	40.241	43.702	51.300	Continuing	Continuing		

#### <u>Note</u>

Note: In FY 2011, increases in funding are due to realignment of technologies from PE 0603401F, Advanced Spacecraft Technology, to this PE in order to better align the technology readiness levels of these efforts.

#### A. Mission Description and Budget Item Justification

This project focuses on three major space technology areas: spacecraft platforms (e.g., structures, controls, power, and thermal management); satellite control (e.g., signal processing and control); and space experiments of maturing technologies for space qualification.

#### **B.** Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
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.	4.164	4.743	4.792	0.000	4.792
<i>FY 2009 Accomplishments:</i> In FY 2009: Refined and validated cryocooler component and system models with experimental data. Investigated thermodynamic loss mechanisms in regenerative cycle cryocoolers through computational fluid dynamics models. Completed design work for improved short-wavelength infrared/ medium-wavelength infrared (SWIR/MWIR) cryocooler application for missile launch detection and technical intelligence mission systems. Completed engineering demonstration of advanced array for thin-film solar cells scaleable to greater than 100 kilowatts (kw).					
FY 2010 Plans: 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					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Feb	ruary 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: Space Technology		<b>PROJECT</b> 628809: <i>Sp</i>	PROJECT 628809: Spacecraft Vehicle Technologies				
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
tube, regenerator and compressor. Continue to investigate the regenerative cycle cryocoolers through computational fluid dyr pulse-tube cryocoolers and multistage coolers from 110 degre subcell technology for thin-film tandem solar cell traceable to g development of material growth and device structures for solar high efficiency solar cells.	namics models, including two-stage es Kelvin to 10 degrees Kelvin. Develop preater than 20% efficiency. Continue							
FY 2011 Base Plans: In FY 2011: Complete cryocooler component and system mod to analyze cryocoolers as a single unit. Correlate thermodyna cycle cryocoolers through computational fluid dynamics model cryocoolers and multistage coolers from 110 degrees Kelvin to results. Begin to develop full-scale design equations for cryoc decreasing manufacturing time by 200%. Demonstrate integra cell. Demonstrate subcomponents of ultra high efficiency sola	mic loss mechanisms in regenerative s, including two-stage pulse tube 0 10 degrees Kelvin to experimental polers, increasing efficiency by 20% and ated, monolithic thin-film tandem solar							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A								
MAJOR THRUST: Develop technologies for advanced space platf FY 2009 Accomplishments: In FY 2009: Developed multifunctional structural hardware con health monitoring, light occultation by nearby objects, and deter Developed system-level architectures for large precision deploy estimation algorithms for better local situational awareness usin hardware, such as star-trackers for object detection, character	ncepts for SSA, such as structural ection of radio frequency (RF) emissions. yable structures. Developed advanced ng existing and next-generation	14.286	12.565	16.906	0.000	16.906		

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 6600: Research, Development, Test & Evaluation, Air Force 8A 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>		<b>PROJECT</b> 628809: <i>Sp</i>	oacecraft Veh	nicle Technol	ogies
Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans: In FY 2010: Continue development of system-level deployable Initiate development of integrated thermal management subsy of satellites. Finish and transition advanced estimation algorith for next-generation systems. Begin development of guidance, built around rapid integration and test of satellite hardware. Be association algorithms for space object tracking. Build represe algorithms. Initiate development of modular plug-and-play spa such concerns as rapid assembly, thermal management, and I FY 2011 Base Plans: In FY 2011: Continue development of integrated thermal man space class of satellites. Initiate the development of nano-rein Continue development of advanced guidance, navigation and and test of satellite hardware. Continue development of data a tracking. Begin development of autonomous guidance, navigation operations. Continue development of modular plug-and-play spa fabrication of engineering model panels, to address such concernation management, and built-in harnesses and electronics.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	stems for responsive space class hms for local situational awareness navigation, and control algorithms egin development of advanced data entative test cases for data association acecraft structural panels to address built-in harnesses and electronics. agement subsystems for responsive forced structures for space applications. control algorithms for rapid integration association tools for space object ation, and control algorithms for proximity spacecraft structural panels, including					
MAJOR THRUST: Develop flight experiments to improve the capa systems and to enable new transformational space capabilities.	bilities of existing operational space	22.796	15.406	14.088	0.000	14.08

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: Space Technology	<b>PROJECT</b> 628809: Spacecraft Vehicle Technolog					
3. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2009 Accomplishments: In FY 2009: Continued ground-based experiments supporting Experiments (DSX) satellite. Delivered host DSX spacecraft b payloads. Continued development of ground support equipment	ous. Began integration and test of DSX						
FY 2010 Plans: In FY 2010: Continue ground-based experiments. Begin DSX Complete DSX payload system-level functional and environme ground support equipment and software.							
FY 2011 Base Plans: In FY 2011: Continue ground-based experiments in support of Complete DSX and payload integration and functional/environ remediation payload. Complete development of ground support	mental testing for radiation belt						
FY 2011 OCO Plans: In FY 2011 OCO: N/A							
Acco	mplishments/Planned Programs Subtotals	41.246	32.714	35.786	0.000	35.78	
		FY 2009	FY 2010	]			
Congressional Add: Multicontinuum Technology for Space Structu	ires.	2.872	0.000				
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Mu Structures.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>		PROJECT 628809: Sµ	pacecraft Vehicle Technologies
B. Accomplishments/Planned Program (\$ in Millions)			1	
		FY 2009	FY 2010	
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Shielding Rocket Payloads.		0.399	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Shi	ielding Rocket Payloads.			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Center for Responsive Space Systems.		0.798	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Ce	nter for Responsive Space Systems.			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Lightweight, High-Efficiency Solar Cells for Sp	pacecraft.	0.798	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Lig Spacecraft.	htweight, High-Efficiency Solar Cells for			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
		1.596	0.000	)

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>		<b>PROJECT</b> 628809: <i>Sp</i>	pacecraft Vehicle Technologies
B. Accomplishments/Planned Program (\$ in Millions)			1	
		FY 2009	FY 2010	]
Congressional Add: Massively Parallel Optical Interconnects for Mic	croSatellite Applications.			-
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Mas MicroSatellite Applications.	sively Parallel Optical Interconnects for			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Center for Solar Electricity and Hydrogen.		3.590	3.983	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Cent	ter for Solar Electricity and Hydrogen.			
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Center	for Solar Electricity and Hydrogen.			
Congressional Add: Advanced Modular Avionics for Operationally R Modular Avionics for Operationally Responsive Satellite Use.	Responsive Space Use/Advanced	2.394	2.470	-
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Adva Operationally Responsive Space Use.	anced Modular Avionics for			
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally-directed effort for Advance Responsive Satellite Use.	ced Modular Avionics for Operationally			
Congressional Add: Center for Space Entrepreneurship.		0.000	1.593	

PPROPRIATION/BUDGET ACTI	, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010			
600: Research, Development, Tes A 2: Applied Research		, Air Force		<b>R-1 ITEM NO</b> PE 0602601	-	-	PROJECT 628809: Spacecraft Vehicle Technologi						
. Accomplishments/Planned Pr	rogram (\$ in M	illions)											
							FY 2009	FY 2010					
FY 2009 Accomplishments: In FY 2009: Not Applicable.													
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congre	ssionally-direct	ed effort for	Center for S	pace Entrep	reneurship.								
Congressional Add: Mission Desig	on and Analysi	s Tool.					0.000	1.593					
FY 2009 Accomplishments: In FY 2009: Not Applicable. FY 2010 Plans: In FY 2010: Conduct Congres	ssionally-direct	ed effort for	Mission Des	sign and Ana	lysis Tool.								
				Congre	ssional Add	s Subtotals	12.447	9.639					
. Other Program Funding Sumr	marv (\$ in Milli	ons)											
	J (,	,	<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					Cost To			
Line Item PE 0602203F: Aerospace Propulsion.	FY 2009 0.000	FY 2010 0.000	<u>Base</u> 0.000	<u>0C0</u> 0.000	<u>Total</u> 0.000	FY 2012 0.000	FY 2013 0.000	FY 2014 0.000	FY 2015 0.000	<u>Complete</u> 0.000	<u>Total Cost</u> 0.000		
PE 0602102F: <i>Materials.</i> PE 0603401F: <i>Advanced</i>	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000		
Spacecraft Technology.													

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010
	<b>R-1 ITEM NOMENCLATURE</b> PE 0602601F: <i>Space Technology</i>	<b>PROJECT</b> 628809: <i>Sp</i>	acecraft Vehicle Technologies

#### **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, RDT&E Budget Item	Justification	: PB 2011 A	ir Force				DATE: February 2010				
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Tes BA 2: Applied Research	R-1 ITEM NOMENCLATURE PE 0602602F: Conventional Munitions										
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	56.596	58.044	61.330	0.000	61.330	60.765	64.988	66.974	64.813	Continuing	Continuing
622068: Advanced Guidance Technology	17.473	17.758	20.039	0.000	20.039	21.133	22.472	23.035	22.540	Continuing	Continuing
622502: Ordnance Technology	39.123	40.286	41.291	0.000	41.291	39.632	42.516	43.939	42.273	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 2009	<u>FY 2010</u>	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	57.407	58.289	0.000	0.000	0.000
Current President's Budget	56.596	58.044	61.330	0.000	61.330
otal Adjustments	-0.811	-0.245	61.330	0.000	61.330
<ul> <li>Congressional General Reductions</li> </ul>		0.000			
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000			
<ul> <li>Congressional Rescissions</li> </ul>	0.000	-0.245			
Congressional Adds		0.000			
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000			
Reprogrammings	0.000	0.000			
SBIR/STTR Transfer	0.000	0.000			
Other Adjustments	-0.811	0.000	61.330	0.000	61.330
ongressional Add Details (\$ in Millions, and Incl	udes General Redu	uctions)			FY 2009 FY 2010
Project: 622502: Ordnance Technology					L

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	chibit R-2, RDT&E Budget Item Justification: PB 2011 Air ForceDATE: F			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602602F: <i>Conventional Munitions</i>			
Congressional Add Details (\$ in Millions, and Includes G	General Reductions)	FY 2009	FY 2010	
Congressional Add: Advanced Nanotube Micro-Munition	n Weapon Technology Initiative.	1.596	0.000	
	Congressional Add Subtotals for Project: 622	02 1.596	0.000	
	Congressional Add Totals for all Proje	cts 1.596	0.000	
Change Summary Explanation				

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

C. Performance Metrics

(U) Under Development.

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research					IOMENCLA 2F: Convent		ons	PROJECT 622068: Advanced Guidance Technology			ology
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
622068: Advanced Guidance Technology	17.473	17.758	20.039	0.000	20.039	21.133	22.472	23.035	22.540	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Investigate and develop advanced guidance component technologies for seekers to increase air-delivered weapon kill probability, reduce pilot workload, and enhance sortie effectiveness.	4.950	9.825	11.504	0.000	11.504
FY 2009 Accomplishments: In FY 2009: Continued laboratory demonstration of test components for laser ranging seeker to profile "single shot" images of targets. Tested and demonstrated an optical seeker that used multi- discriminate signatures to improve targeting obscured targets. Refined Synthetic Aperture Radar system simulation. Began developing a multimode seeker that provided improved performance in two wavelength bands.					
FY 2010 Plans: In FY 2010: Continue laboratory demonstration of test components for laser ranging seeker to profile "single shot" images of 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					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602602F: Conventional Munitic	<b>PROJECT</b> 622068: <i>Ac</i>	T Idvanced Guidance Technology			
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
under Global Positioning System (GPS)-denied conditions. Ver simulation. Conduct tests on optical flow enhanced seeker.	rify polarization theory models through					
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Continue laboratory demonstration of test compon "single shot" images of targets. Complete demonstration of opt signatures to improve targeting obscure targets. Continue deve provides improved performance in two wavelength bands. Com use wide field of view optical imager data to augment map-mate under GPS-denied conditions. Complete verification of polariza Conduct tests on optical flow enhanced seeker.</li> <li>FY 2011 OCO Plans:</li> </ul>	tical seeker that uses multi-discriminate elopment of multimode seeker that itinue development of algorithms to ching techniques, enabling navigation					
In FY 2011 OCO: N/A. MAJOR THRUST: Investigate and develop advanced navigation ar	•	3.366	3.900	4.566	0.000	4.566
<ul> <li>munitions to improve stand off ranges, resistance to GPS jamming,</li> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Continued applying the neuro-physiology of insect targets in urban-like environments. Continued evaluating navig environments. Evaluated utility data links to provide target loca time sensitive targets. Investigated guidance navigation and co agility, reduced signature targets. Investigated technologies ap facilities.</li> </ul>	s to guide small vehicles to moving ation systems within GPS jamming ition updates for precision strike against ontrol algorithms for engaging high					
FY 2010 Plans: In FY 2010: Continue applying the neuro-physiology of insects targets in urban-like environments. Continue evaluating naviga	•					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602602F: <i>Conventional Muniti</i>	ons	<b>PROJECT</b> 622068: Advanced Guidance Techn			ology
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
environments. Continue maturing technologies allowing weap probability of detection mode with launch platforms, submuniti integrated multi-UAV search and attack demonstration on a tir	ons, and/or ground elements. Begin					
FY 2011 Base Plans: In FY 2011: Continue applying the neuro-physiology of insect targets in urban-like environments. Continue evaluating navig environments. Continue maturing technologies allowing weap probability of detection mode with launch platforms, submuniti integrated multi-UAV search and attack demonstration on a tir guidance technologies that optimize delivery of selectable effe	pation systems within GPS jamming bons to communicate in a secure, low ons, and/or ground elements. Continue me critical moving target. Investigate					
FY 2011 OCO Plans: In FY 2011 OCO: N/A.						
MAJOR THRUST: Investigate and develop advanced optical and classification, and identification algorithms for improved seeker per	• •	3.752	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Continued verifying biomimetic models through s polarization theory models through simulation. Conducted tes	•					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602602F: Conventional Munition	ns	<b>PROJECT</b> 622068: <i>Ad</i>	CT Advanced Guidance Technology			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Using a system approach, investigate and deve guidance, navigation and control, and seekers.	elop weapons by making trades between	5.405	4.033	3.969	0.000	3.969	
FY 2009 Accomplishments: In FY 2009: Continued refining the set of interoperable simula technologies. Integrated and tested updates for multi-spectral updated results via synthetic scene simulation. Continued the generation capability for hardware-in-the-loop testing.	phenomenology models and evaluated						
FY 2010 Plans: In FY 2010: Continue refining the set of interoperable simulati technologies. Simulate different highly innovative concepts ar technology.							
FY 2011 Base Plans: In FY 2011: Continue refining the set of interoperable simulati technologies. Simulate highly innovative concepts and approa technology. Develop capability to test and refine development in a realistic operational environment.	aches in guidance and control						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
	mplishments/Planned Programs Subtotals	17.473	17.758	20.039	0.000	20.039	

Exhibit R-2A, RDT&E Project Jus	stification: PB	2011 Air Fo	rce						DATE: February 2010			
APPROPRIATION/BUDGET ACTI 3600: Research, Development, Te BA 2: Applied Research		<b>R-1 ITEM NO</b> PE 0602602		<b>PROJECT</b> 622068: Advanced Guidance Technology								
C. Other Program Funding Sumr	mary (\$ in Mill	ions)										
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>		
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost	
• PE 0603601F: Conventional	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Weapons Technology.												
D. Acquisition Strategy												
Not Applicable.												
E. Performance Metrics												
Please refer to the Performance	Base Budget C	verview Boo	k for inforn	nation on how	Air Force re	esources are	applied an	d how those	resources a	re contributi	na to Air	
Force performance goals and mo	•											
	· · · · · · · · · · · · · · · · · · ·	,										

Exhibit R-2A, RDT&E Project Jus	tification: PE	3 2011 Air F	orce							DATE: February 2010		
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Tes BA 2: Applied Research		IOMENCLA 2F: Convent	TURE ional Munitic	ns	<b>PROJECT</b> 622502: Ordnance Technology							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
622502: Ordnance Technology	39.123	40.286	41.291	0.000	41.291	39.632	42.516	43.939	42.273	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Investigate and develop high fidelity analytical tools for predicting weapons' effects and assessing target vulnerability to reduce development costs and provide maximum lethality.	8.400	0.000	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Modeled damage to buildings caused by direct weapon effects. Continued developing capability to apply first principles computational tools to design and evaluation of new munitions concepts. Continued to identify high payoff technologies for defeating mobile targets. Applied system level analysis tools to identify promising high payoff technologies for defeating mobile targets.					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.					
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602602F: Conventional Muniti	T Drdnance Technology				
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Investigate and develop energetic materials teo lethality, while applying appropriate safety and security features.	hnology that can maximize weapon	6.638	9.617	9.364	0.000	9.364
FY 2009 Accomplishments: In FY 2009: Continued developing highly energetic material w conventional explosives by characterizing advanced convention the sensitivity and detonation performance and developed pro Continued developing a materials properties database characteric	nal explosive formulations. Evaluated cesses of new energetic materials.					
FY 2010 Plans: In FY 2010: Continue developing the materials properties data for predicting initiation. Develop explosive fills that reduce pre Investigate low-density energetic materials for use in micro-mu materials capable of enhancing warhead performance.	-detonation during high "G" loading.					
FY 2011 Base Plans: In FY 2011: Complete the materials properties data base to d predicting initiation. Test and model explosive fills that reduce Develop low-density energetic materials for micro-munitions a case materials to tailor or improve warhead performance.	pre-detonation during high "G" loading.					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Investigate and develop fuzes for air-delivered energetic initiation concepts, penetration fuzing, point burst fuzes,		5.944	6.016	7.237	0.000	7.237

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602602F: <i>Conventional Munitic</i>	<b>PROJECT</b> 622502: <i>Or</i>	T Drdnance Technology			
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Demonstrated a miniature fuze that provides safe a low power initiator in a four cubic inch package. Continued investigating miniature components to trans</li> <li>FY 2010 Plans:</li> <li>In FY 2010: Continue investigating novel methods to initiate extensing techniques. Investigate the mechanical environment that</li> </ul>	estigating novel methods to initiate mit bomb damage information. plosives, including new modeling and it a fuze must survive during hard					
target penetration events. Explore ground profiling imaging fuze hardened chip fuze that uses integrated logic.	e technology. Begin investigating a					
FY 2011 Base Plans: In FY 2011: Continue investigating novel methods to initiate ex testing techniques. Continue to investigate and characterize the must survive during hard target penetration events. Explore gro Continue development of a hardened chip fuze that uses integra	e mechanical environment that a fuze bund profiling imaging fuze technology.					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Using a system approach, investigate and devel trades between fuzes, warheads, and explosives.	op weapons by making technology	8.718	12.283	12.450	0.000	12.450
FY 2009 Accomplishments: In FY 2009: Completed development of third spiral of covert vio transmitted data to coordinate attacks of enemy targets. Contin for dual role area dominance missile technology. Continued inv guided munitions by performing subsystem design trade studies technologies for aerospace applications.	ued investigating reaction jet control estigating the design of precision					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602602F: <i>Conventional Munitic</i>	<b>PROJECT</b> 622502: Ordnance Technology				
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans: In FY 2010: Complete investigation of reaction jet control for dual precision guided munitions, investigate issues of integrating minit in various flight environments. Develop and use a set of interoped emerging munition technologies. Develop and enhance models counter-chemical, biological, radiological, and nuclear effects.</li> <li>FY 2011 Base Plans: In FY 2011: Continue investigation of precision guided munition in various flight environments. Continue building and using intermemerging technologies. Continue developing and enhancing new micromunitions, penetrators, and counter-chemical, biological, radiological, radiological, radiological, radiological, penetrators, and counter-chemical, biological, radiological, radiological, penetrators.</li> </ul>	aturized components and functionality erable simulations to evaluate for micromunitions, penetrators, and ntegration issues and functionality operable simulations to evaluate w models and improvements for					
In FY 2011 OCO: N/A. MAJOR THRUST: Investigate and develop advanced warhead kill m warheads, directional control, fragmenting warheads, and application	· · · · · · · · · · · · · · · · · · ·	7.827	12.370	12.240	0.000	12.240
FY 2009 Accomplishments: In FY 2009: Completed evaluation of selected materials for high hard nose-caps against hard and combination targets. Continue generation warhead cases with the eventual goal of terradynamic of shaped charges to defeat medium and heavy armor. Continue technologies to neutralize electronics with small robotic weapons high velocity UAV deliverable with strength to defeat hardened ta submunition technology that provides agent defeat mechanisms investigations into new mechanisms for defeating agent defeat ta	-speed penetrating weapons and the d investigating high strength next c steering. Continued evaluation ed investigating micro-damage s. Continued developing a small argets. Continued investigating against hardened targets. Began					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010					
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				<b>ROJECT</b> 22502: Ordnance Technology			
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Complete investigation of high strength next general goal of terradynamic steering. Complete evaluation of shaped of armor. Complete investigation of micro-damage technologies to delivered small robotic weapons. Explore compact lethality war terrain. Begin investigating directional warhead concepts emplor standoff kills for non-direct hit encounters. Develop numerical a interface dynamics, loading, and vibration during high speed per control, direct, and focus the energy release from explosives in a amounts of electromagnetic energy.</li> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Develop compact lethality warhead technologies for investigating directional warhead concepts employing reactive fit non-direct hit encounters. Continue developing numerical algor dynamics, loading, and vibration during high speed penetration. to control, direct, and focus the energy release from explosives is small amounts of electromagnetic energy.</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: N/A.</li> </ul>	charges to defeat medium and heavy o neutralize electronics with air head technologies for use in urban bying reactive fragments to improve Igorithms for material-to-material netration. Investigate techniques to real-time by means of applying small or use in urban terrain. Continue ragments to improve standoff kills for ithms for material-to-material interface Continue investigating techniques in real-time by means of applying						
Accom	plishments/Planned Programs Subtotals	37.527	40.286	41.291	0.000	41.291	
		FY 2009	FY 2010	]			
Congressional Add: Advanced Nanotube Micro-Munition Weapon T	echnology Initiative.	1.596	0.000				

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research			<b>R-1 ITEM N</b> PE 0602602	-	-	PROJECT 622502: Ordnance Technology					
B. Accomplishments/Planned Pr	ogram (\$ in M	illions)						1			
							FY 2009	FY 2010			
FY 2009 Accomplishments: In FY 2009: Conducted Cong Technology Initiative.	ressionally-dire	ected effort f	for the Adva	inced Nanotu	be Micro-Mi	unitions					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
	Congressional Adds Subtotals							0.000			
C. Other Program Funding Summ	nany (\$ in Milli	ione)							1		
C. Other Program Funding Sum		<u>10115)</u>	FY 2011	FY 2011	FY 2011					Cost To	
Line Item • PE 0603601F: Conventional Weapons Technology.	FY 2009 0.000	<u>FY 2010</u> 0.000	<b>Base</b> 0.000	0C0 0.000	<u>Total</u> 0.000	FY 2012 0.000	FY 2013 0.000		FY 2015 0.000	<u>Complete</u> 0.000	<u>Total Cos</u> 0.000
<b>D. Acquisition Strategy</b> Not Applicable.											
<b><u>E. Performance Metrics</u></b> Please refer to the Performance B Force performance goals and mo					/ Air Force r	esources are	e applied an	id how those	resources a	re contributi	ng to Air

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Exhibit R-2, RDT&E Budget Item J	ustification	: PB 2011 A	ir Force					DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIV</b> 3600: Research, Development, Test BA 2: Applied Research		n, Air Force		R-1 ITEM NOMENCLATURE PE 0602605F: DIRECTED ENERGY TECHNOLOGY							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	60.233	105.231	103.596	0.000	103.596	112.629	119.405	123.200	126.394	Continuing	Continuing
624866: Lasers & Imaging Technology	35.680	73.826	77.821	0.000	77.821	85.420	89.125	92.029	94.793	Continuing	Continuing
624867: Advanced Weapons & Survivability Technology	18.682	31.405	25.775	0.000	25.775	27.209	30.280	31.171	31.601	Continuing	Continuing
6255SP: Laser and Imaging Space Tech	5.871	0.000	0.000	0.000	0.000	0.000	0.000	0.000	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.

### **B. Program Change Summary (\$ in Millions)**

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	62.701	105.677	0.000	0.000	0.000
Current President's Budget	60.233	105.231	103.596	0.000	103.596
Total Adjustments	-2.468	-0.446	103.596	0.000	103.596
<ul> <li>Congressional General Reductions</li> </ul>		0.000			
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000			
<ul> <li>Congressional Rescissions</li> </ul>	0.000	-0.446			
<ul> <li>Congressional Adds</li> </ul>		0.000			
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000			
Reprogrammings	0.000	0.000			
SBIR/STTR Transfer	0.000	0.000			
<ul> <li>Other Adjustments</li> </ul>	-2.468	0.000	103.596	0.000	103.596

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force		DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602605F: <i>DIRECTED ENERGY TECHNOLOGY</i>	

### **Change Summary Explanation**

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

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.

Note: In FY 2010, Congress added \$0.8 million for Hybrid Nanoparticle-based Coolant Technology Development and Manufacturing that has been moved to PE 0602102F, Materials, Project 624347, for execution.

C. Performance Metrics Under Development.

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force										DATE: February 2010			
<b>APPROPRIATION/BUDGET ACT</b> 3600: <i>Research, Development, Te</i> BA 2: <i>Applied Research</i>	Research, Development, Test & Evaluation, Air Force Applied Research				<b>IOMENCLA</b> 5F: <i>DIRECT</i> DGY	<b>TURE</b> ED ENERG`	Y	<b>PROJECT</b> 624866: Lasers & Imaging Technology					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost		
624866: Lasers & Imaging Technology	35.680	73.826	77.821	0.000	77.821	85.420	89.125	92.029	94.793	Continuing	Continuing		

#### <u>Note</u>

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, and precision engagement. 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop electric laser technologies for airborne tactical applications. Technologies include fiber, bulk solid state, semiconductor, and other electrically powered lasers.	16.200	28.132	33.241	0.000	33.241
FY 2009 Accomplishments: In FY 2009: Improved design of laser sources for aircraft self-protection. Demonstrated system- level beam control solutions to aero-optical issues of tactical laser weapons applications on airborne platforms. Continued to assess the effectiveness of various laser concepts in relevant scenarios. Continued to scale electric lasers up to the weapons class power level. Developed architectures that are suitable in terms of size, weight, efficiency, affordability, reliability, maintainability, supportability, environmental acceptability, and ruggedness for the next-generation applications. Performed damage/					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F: DIRECTED ENERG TECHNOLOGY	PE 0602605F: <i>DIRECTED ENERGY</i> 624866					
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>vulnerability tests against real or simulated systems. Used test laser effectiveness/system vulnerabilities.</li> <li><i>FY 2010 Plans:</i></li> <li>In FY 2010: Develop technologies, building on previous laser joint service and agency technology advances, to support desi demonstrator for inclusion on a large aircraft. Enhance design protection and refine system packaging. Improve system arch of size, weight, efficiency, affordability, reliability, maintainabilit acceptability, and ruggedness for the next-generation applicati that can be used on a future airborne tactical laser system. Cot tests against real and/or simulated systems. Use test results the effectiveness/system vulnerabilities.</li> </ul>	development efforts and incorporating gning a weapon-class electric laser of laser sources for aircraft self- itectures that are suitable in terms cy, supportability, environmental ons. Develop fiber laser technologies pontinue damage/vulnerability						
FY 2011 Base Plans: In FY 2011: Continue research supporting design and fabricat components, including fiber lasers, for potential inclusion on a components and subsystems incorporating advances for therm sources for aircraft self-protection and improve system packag powered laser concepts. Continue damage/vulnerability tests Use test results to verify models and assess laser effectiveness modeling and simulation of advanced electric laser concepts for	large aircraft. Begin testing of nal management. Ruggedize laser ing. Develop advanced electrically- against real and/or simulated systems. s/system vulnerabilities. Improve						
FY 2011 OCO Plans: In FY 2011 OCO: N/A							
MAJOR THRUST: Develop chemical laser technologies for scalab devices with improved efficiency.	ble, strategic-class high energy laser	4.918	5.977	2.280	0.000	2.280	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602605F: <i>DIRECTED ENERGY</i> <i>TECHNOLOGY</i>	Y	<b>PROJECT</b> 624866: <i>La</i>	sers & Imag	ing Technolo	gy
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Demonstrated high-performance singlet delta oxy nozzle concepts for airborne laser applications based on result scaled electric discharge oxygen-iodine lasers and refined dioc Improved modeling and simulation of chemical, hybrid, and dio	ts of previous analysis. Demonstrated de-pumped atomic laser concepts.					
FY 2010 Plans: In FY 2010: Continue efforts to improve laser nozzle and gene of chemical oxygen-iodine lasers such as those on the Airborn pumped atomic laser concept scaling capability. Continue to in chemical, hybrid, and diode-pumped lasers.	e Laser. Demonstrate initial diode-					
FY 2011 Base Plans: In FY 2011: Continue to improve and use modeling and simu research to support future multi-megawatt-class high energy la types of lasers that have demonstrated the megawatt power ca applications. A continued research capability in this technolog range revolutionary applications and to maintain expertise in ve	sers. Chemical lasers are the only apabilities required for strategic y is required to support these long-					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop and demonstrate optical technologies compensation, pointing and tracking, and integration of optical sys	tems with the laser device.	9.825	13.643	10.315	0.000	10.315
In FY 2009: Continued initial demonstration of system-level so associated with airborne tactical laser weapons systems in wir of major subsystems for the tactical relay mirror demonstrator.	d-tunnel environment. Began assembly					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F: DIRECTED ENERGY TECHNOLOGY	<b>PROJECT</b> 624866: Lasers & Imaging Technology				
B. Accomplishments/Planned Program (\$ in Millions)	I		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
concepts for laboratory demonstrations of long horizontal path p improvements for consideration of system performance and mis systems on large aircraft. Completed initial design of a demons DARPA's High Energy Liquid Laser Area Defense System device	sion suitability for solid state laser strator laser weapon system based on					
FY 2010 Plans: In FY 2010: Demonstrate in the laboratory selected atmospher laboratory long horizontal path propagation. Continue final tact laboratory testing of major subsystems for the demonstrator. C Complete component research and modeling and simulation effield demonstration of a high power solid state laser with a bear	cal relay mirror assembly and begin ontinue aero-optics wind tunnel tests. orts supporting the joint AF/DARPA					
FY 2011 Base Plans: In FY 2011: Continue laboratory testing on horizontal propagat begin planning for field testing. Begin tactical relay mirror demo laser communications research focused on ultra-high data rate, including atmospheric signal degradation. Funding decrease in 2010 of the applied research support to the joint AF/DARPA fiel state laser with a beam control system.	free-space, secure communications FY 2011 is due to completion in FY					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop advanced, long-range, optical technolog awareness (SSA) systems.	gies that support future space situational	4.737	26.074	31.985	0.000	31.98

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F: DIRECTED ENERGY TECHNOLOGY	Y	<b>PROJECT</b> 624866: <i>La</i>	sers & Imag	ing Technold	рду
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 201 <sup>2</sup> Total
FY 2009 Accomplishments: In FY 2009: Integrated second-generation sodium beacon ada telescope and prepared for demonstrations of compensated in at visible and near-infrared wavelengths.						
FY 2010 Plans: In FY 2010: Complete system tests of second-generation sod on 3.5 meter telescope and perform demonstrations of compet- very dim objects at visible and near-infrared wavelengths. Dev and system level technologies to advance space situational av active imaging techniques and demonstrate imaging and non-i techniques. Develop assessment methodologies by incorpora illumination, tracking, and compensated imaging; from results analysis; and from enhanced numerical techniques. Support of algorithms, predictive avoidance databases and assessment of Develop tools supporting analysis, modeling, and simulation.	nsated imaging and detection of velop, integrate, and test component vareness. Investigate passive and maging space-object identification ting new experimental data from laser of space materials properties and aging operational SSA mission planning tools,					
FY 2011 Base Plans: In FY 2011: Assess capabilities of second-generation sodium on 3.5 meter telescope through demonstrations of compensate dim objects at visible and near-infrared wavelengths. Continue of active and passive imaging techniques using the 3.5 meter adaptive optics. Assess non-conventional imaging methods. test component and system level technologies to advance SS/ assessment methodologies by incorporating new experimenta	ed imaging and detection of very e development and demonstration telescope and second-generation Develop, refine, integrate, and					

Exhibit R-2A, RDT&E Project Justif	fication: PB	2011 Air Fo	orce						DATE: Febr	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVIT</b> 3600: Research, Development, Test & BA 2: Applied Research		, Air Force		<b>R-1 ITEM N</b> PE 0602605 <i>TECHNOLO</i>	F: DIRECTE		/	<b>PROJECT</b> 624866: <i>La</i> s	asers & Imaging Technology		
B. Accomplishments/Planned Prog	ıram (\$ in M	lillions)	·					-			
		,					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
avoidance, and space situational techniques by updating and trans						S.					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A											
			Accomplish	ments/Plann	ed Program	s Subtotals	35.680	73.826	77.821	0.000	77.821
C. Other Program Funding Summar	rv (\$ in Milli	ions)									
	<u>, y</u> ( <del>y</del>		FY 2011	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	FY 2010	Base	000	Total	FY 2012	FY 2013	FY 2014	FY 2015	Complete	<b>Total Cost</b>
• PE 0601108F: <i>High Energy</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Laser Research Initiatives.											
• PE 0602890F: High Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Laser Research.											
• PE 0603444F: Maui Space	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Surveillance System.											
• PE 0603605F: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Weapons Technology. • PE 0603924F: High Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Laser Advanced Technology	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Program.											
• PE 0602120A: Sensors and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Electronic Survivability.											
• PE 0602307A: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Weapons Technology.											
• PE 0602624A: Weapons and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Munitions Technology.											

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	orce					DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVI</b> 3600: Research, Development, Test BA 2: Applied Research		, Air Force		<b>R-1 ITEM NO</b> PE 0602605 <i>TECHNOLO</i>	<b>PROJECT</b> 624866: Lasers & Imaging Technology							
C. Other Program Funding Summa	ary (\$ in Mill	ions)		1				1				
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>		
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost	
• PE 0603004A: Weapons and												
Munitions Advanced Technology.												
• PE 0602114N: Power Projection	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Applied Research.												
• PE 0602702E: <i>Tactical</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Technology.												
• PE 0603175C: Ballistic Missile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Defense Technology.												
• PE 0603883C: Ballistic Missile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Defense Boost Phase Segment.												
• PE 0602651M: Joint Non-Lethal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Weapons Applied Research.												
• PE 0603651M: Joint Non-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Lethal Weapons Technology												
Development.												
D. Acquisition Strategy												
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-2A, RDT&E Project Just	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force										
APPROPRIATION/BUDGET ACTIN 3600: Research, Development, Test BA 2: Applied Research					Y	<b>PROJECT</b> 624867: Advanced Weapons & Survivabilit Technology					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
624867: Advanced Weapons & Survivability Technology	18.682	31.405	25.775	0.000	25.775	27.209	30.280	31.171	31.601	Continuing	Continuing

### A. Mission Description and Budget Item Justification

This project explores high power microwave (HPM) and other unconventional weapon concepts using innovative technologies. Research is conducted 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Investigate technologies for HPM components for applications such as disruption of electronic systems. Investigate other unconventional weapon concepts using innovative technologies.	11.201	15.499	10.922	0.000	10.922
FY 2009 Accomplishments: In FY 2009: Enhanced the compact repetitively pulsed gigawatt-class HPM testbed. Integrated and demonstrated a conformal antenna and command and control system for the compact HPM testbed. Designed and developed narrowband HPM components that will be integrated into a demonstration aerial platform. Demonstrated mature HPM source materials and continued assessing the applicability of solid state subsystem designs supporting ruggedized high power airborne systems. Improved the wideband antenna and high voltage switch and demonstrated improved effectiveness during field tests. Developed apparatus capable of correctly delivering gas into interaction region of HPM tubes. Investigated HPM concepts related to cyber warfare and studied the possibility of developing new HPM waveforms for a counter-electronics application. Implemented the enhanced options for high power subsystem components based on the results of the HPM system source code. Designed/ developed state-of-the-art energy storage power components.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F: DIRECTED ENERGY TECHNOLOGY	(	PROJECT 624867: Ac Technology	Advanced Weapons & Survivability				
B. Accomplishments/Planned Program (\$ in Millions)			-					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Develop and evaluate components of the narrowb Investigate electromagnetic interference/electromagnetic capa Continue investigations of integrating a wideband HPM system Conduct laboratory experiments using new types of HPM wave applications. Advance and utilize state-of-the-art energy storag components. Design hardware to generate high energy densit validation, for applications such as countering weapons of mas</li> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Continue development of advanced HPM compor effect prediction to a suite of HPM-related codes. Continue mi other government systems. Further refine models for use in H to investigate state-of-the-art energy storage components. Co experiments for applications such as countering weapons of m</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	bility of narrowband HPM components. a into small unmanned aerial vehicles. eforms for counter-electronics ge components within pulsed-power by plasmas, based on experimental as destruction. ments. Apply advances in target tigation efforts for Air Force and PM system development. Continue nduct high energy density plasma							
MAJOR THRUST: Assess the effects/lethality of HPM technologies and apply sophisticated models to enhance the development of HP <i>FY 2009 Accomplishments:</i> In FY 2009: Applied physics-based understanding and models incorporated capabilities into an engagement model. Continue	M and related technology.	5.530	6.206	6.240	0.000	6.240		
software. Expanded microwave effects mitigation effort to hard red systems. Verified linkages between components in an HPI improved field and thermal emission models. Began upgrade effects testing at frequencies as high as 35 gigahertz.	den additional Air Force systems against M system. Integrated, verified, and							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	R-1 ITEM NOMENCLATURE PE 0602605F: DIRECTED ENERG TECHNOLOGY	Y	PROJECT 624867: Ac Technology	dvanced Weapons & Survivability				
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
FY 2010 Plans: In FY 2010: Expand modeling capabilities to include accurate reduced user inputs. Continue effects mitigation efforts on sys systems to include modern tactical aircraft components. Unite to-end simulation and design efforts. Complete infrastructure testing on subsystems to cover all HPM frequencies currently	stems of interest and expand into new e multiple HPM-related models for end- updates to enable representative effects							
FY 2011 Base Plans: In FY 2011: Continue effects mitigation efforts on systems of components. Apply advances in target effect prediction to a s mitigation efforts for Air Force and other US government syste system development.	uite of HPM-related codes. Continue							
FY 2011 OCO Plans: In FY 2011 OCO: N/A								
MAJOR THRUST: Investigate advanced technologies that suppor including non-lethal counter-personnel applications from an airborr		1.951	9.700	8.613	0.000	8.613		
FY 2009 Accomplishments: In FY 2009: Continued main design work for test stand for full demonstration. Continued development of advanced modeling harmonic and fundamental mode sources. Completed next ph study.	g codes that incorporate ability to model							
FY 2010 Plans: In FY 2010: Complete design and continue research work for radiating system demonstration for airborne application. Cont modeling codes that incorporate ability to model harmonic sou	inue development and use of advanced							

Exhibit R-2A, RDT&E Project Justi	ification: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 2: Applied Research		, Air Force		<b>R-1 ITEM NO</b> PE 0602605 <i>TECHNOLO</i>	F: <i>DIRECTE</i>		/	PROJECT 624867: Ad Technology	lvanced Wea	apons & Sur	vivability
B. Accomplishments/Planned Pro	gram (\$ in M	lillions)									
-		·					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
evaluation of source and therma harmonic source development.	al subsystem	options for	next-generat	tion non-letha	al systems.	Begin					
In FY 2011: Continue working to Denial Technology (AADT) com of the Airborne Active Denial 2.3 airborne gyrotron source compu- conditioning approaches, as we mitigation techniques. Perform source. Perform engagement re research and develop alternative <i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A	ponents. Pe 5 megawatt g uter model. ( ell as antenna computer mo nodeling and	erform full-po gyrotron sou Continue dev and beam odeling and simulation o	owered, long rce. Continu- velopment of conditioning simulation of of an Active I	-pulse, high o ie to improve AADT prime systems, inc f a next-gene	duty-cycle te fidelity of power and luding air br eration Active	esting power eakdown e Denial					
			Accomplish	ments/Plann	ed Program	s Subtotals	18.682	31.405	25.775	0.000	25.77
C. Other Program Funding Summa	ary (\$ in Mill	ions)	EV 0044	EV 0044	EV 0044				1	0 1 T-	1
Line Item	FY 2009	FY 2010	<u>FY 2011</u> Base	<u>FY 2011</u> OCO	<u>FY 2011</u> <u>Total</u>	FY 2012	FY 2013	FY 2014	EV 2015	<u>Cost To</u> Complete	
• PE 0602202F: Human Systems	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Technology.	2.000	0.000	0.000	0.000	2.000	0.000	5.000	0.000	0.000	0.000	0.00
• PE 0603605F: Advanced Weapons Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0602120A: Sensors and Electronic Survivability	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602624A: Weapons and Munitions Technology	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justif	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVI</b> 3600: <i>Research, Development, Test o</i> BA 2: <i>Applied Research</i>		, Air Force		R-1 ITEM NO PE 0602605 TECHNOLO	F: DIRECTE			<b>PROJECT</b> 624867: Ad Technology		/ivability	
C. Other Program Funding Summa	ry (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					Cost To	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<b>Complete</b>	Total Cost
• PE 0602114N: Power Projection	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602651M-A: Joint Non-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lethal Weapons Applied Research.											
• PE 0603851M: Nonlethal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Weapons											

### **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, RDT&E Project Just	ification: PE	3 2011 Air Fo	orce						DATE: February 2010			
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 2: Applied Research					<b>PROJECT</b> 6255SP: <i>La</i>	T Laser and Imaging Space Tech						
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
6255SP: Laser and Imaging Space Tech	5.871	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing	

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop advanced, long-range, optical technologies that support future space-object imaging systems.	2.444	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Tested electrostatic deformable mirror technologies to determine maturity and utility for Air Force applications. Developed and demonstrated 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.					
FY 2010 Plans: In FY 2010: This thrust has been moved to Project 4866, Laser and Imaging Technology, in order to better align efforts.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602605F: <i>DIRECTED ENERG</i> <i>TECHNOLOGY</i>	Y	PROJECT 6255SP: La	T Laser and Imaging Space Tech				
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
FY 2011 Base Plans: In FY 2011: Not Applicable. FY 2011 OCO Plans: In FY 2011 OCO: N/A								
MAJOR THRUST: Assess the vulnerability of U.S. satellites to the and update catalogued satellites.	effects of high-energy laser weapons	3.427	0.000	0.000	0.000	0.000		
FY 2009 Accomplishments: In FY 2009: Expanded analysis capabilities to provide assess systems from new and emerging directed energy concepts. Re methodologies by incorporating new experimental data from la compensated imaging; results of space materials properties ar numerical techniques. Continued support of operational missio avoidance, and space situational awareness by updating and t capabilities. Integrated and tested advanced optical and infrar telescope and second generation sodium beacon adaptive opt detection, and imaging.	efined and broadened assessment ser illumination, tracking, and d aging analysis; and enhanced on planning tools, algorithms, predictive ransitioning databases and assessment ed sensor systems with 3.5 meter							
FY 2010 Plans: In FY 2010: This thrust has been moved to Project 4866, Lase better align efforts.	r and Imaging Technology, in order to							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.								
FY 2011 OCO Plans: In FY 2011 OCO: N/A								

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fc	orce						DATE: Febr	uary 2010		
APPROPRIATION/BUDGET ACTIVI 3600: Research, Development, Test BA 2: Applied Research		, Air Force		<b>R-1 ITEM NO</b> PE 0602605 <i>TECHNOLO</i>	F: <i>DIRECTE</i>		,	<b>PROJECT</b> 6255SP: Laser and Imaging Space Tech				
B. Accomplishments/Planned Prog	gram (\$ in M	lillions)										
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
			Accomplish	nments/Plann	ed Program	s Subtotals	5.871	0.000	0.000	0.000	0.00	
C. Other Program Funding Summa	rv (\$ in Mill	ions)										
<u> </u>	<b></b>	<u></u>	<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>		
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cos	
• PE 0603444F: Maui Space	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Surveillance Systems.												
• PE 0603605F: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
Weapons Technology.												
• PE 0601108F: High Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
Laser Research Initiatives.												
• PE 0602890F: High Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
Laser Research.												
• PE 0603924F: High Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
Laser Advanced Technology												
Program.	0.000	0.000	0.000	0.000	0.000	0.000	0 000	0.000	0.000	0.000	0.00	
• PE 0603883C-A: Ballistic Missile Defense Boost Phase Segment.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
• PE 0602120A: Sensors and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
Electronic Survivability.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
• PE 0602307A: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
Weapons Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
• PE 0602624A: Weapons and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
Munitions Technology.		0.000		0.000	0.000	0.000		0.000	0.000		2.00	
• PE 0603004A: Weapons and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
Munitions Advanced Technology.												
• PE 0602114N: Power Projection	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
Applied Research.												

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010		
					<b>DMENCLAT</b> F: <i>DIRECTE</i> GY	<b>URE</b> D ENERGY		<b>PROJECT</b> 6255SP: <i>Laser and Imaging Space Tech</i>				
C. Other Program Funding Summa	ary (\$ in Mill	ions)										
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>		
Line Item	FY 2009	<u>FY 2010</u>	<u>Base</u>	<u>000</u>	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost	
• PE 0602702E: <i>Tactical</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Technology.												
• PE 0603175C: Ballistic Missile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Defense Technology.												
• PE 0603883C-B: Ballistic Missile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Defense Boost Phase Segment.												
• PE 0602651M-B: Joint Non-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Lethal Weapons Applied Research.												
• PE 0602651M-C: Joint Non-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Lethal Weapons Applied Research.												

### **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, RDT&E Budget Item						DATE: Feb	ruary 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 2: Applied Research				I <b>OMENCLA</b> 2F: <i>Commar</i>	TURE nd Control ar						
COST (\$ in Millions)FY 2009 FY 2009 ActualFY 2010 FY 2010 EstimateFY 201 Base EstimateT. t. I. D. source Flower flower444.5400.0000.000				FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	114.510	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
624519: Communications Technology	35.871	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
624594: Information Technology	30.804	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
625581: Command and Control (C2) Technology	38.385	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
6266SP: Space Optical Network Tech	9.450	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### <u>Note</u>

Note: In FY 2010, efforts in this PE moved 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.

ir Force			DATE:	February 2010	)
	-	-	nications		
FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	<u>FY 2011</u>	Total
115.559	0.000	0.000	0.000		0.000
114.510	0.000	0.000	0.000		0.000
-1.049	0.000	0.000	0.000		0.000
	0.000				
	0.000				
0.000	0.000				
	0.000				
	0.000				
0.000	0.000				
0.000	0.000				
-1.049	0.000	0.000	0.000		0.000
udes General Rec	ductions)		[	FY 2009	FY 2010
			-		
ommon Data Link.			_	1.596	0.00
	Conç	gressional Add Subtotals	s for Project: 624519	1.596	0.00
		Congressional Add 1	Totals for all Projects	1.596	0.00
	FY 2009           115.559           114.510           -1.049           0.000           0.000           -1.049	FY 2009         FY 2010           115.559         0.000           114.510         0.000           -1.049         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000           0.000         0.000	FY 2009         FY 2010         FY 2011 Base           115.559         0.000         0.000           114.510         0.000         0.000           -1.049         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000           0.000         0.000         0.000	FY 2009         FY 2010         FY 2011 Base         FY 2011 OCO           115.559         0.000         0.000         0.000           114.510         0.000         0.000         0.000           -1.049         0.000         0.000         0.000           0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000	FY 2009         FY 2010         FY 2011 Base         FY 2011 OCO         FY 2011           115.559         0.000         0.000         0.000         114.510         0.000         0.000           114.510         0.000         0.000         0.000         0.000         0.000           -1.049         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000         0.000         0.000         0.000         0.000         0.000         0.000         0.000         0.000         0.000         0.000         0.000         0.000

Note: In FY 2010, Congress added \$2.0 million for Efficient Utilization of Transmission Hyperspace. These efforts were transfered to PE 0602788F, Dominant Informantion Technology, via Form 1414. The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner. C. Performance Metrics Under Development.

Exhibit R-2A, RDT&E Project Ju	stification: Pl	3 2011 Air F	orce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				IOMENCLA 2F: Commar ations		nd	PROJECT 624519: Communications Technology				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
624519: Communications Technology	35.871	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop assured and survivable information and networking technologies enabling worldwide command, control, surveillance, reconnaissance, and exploitation operations.	9.698	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Completed 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. Designed and developed airborne network modeling and simulation technology. Developed cognitive networking technology that senses operating environment, learns application requirements, and adapts network protocols. Completed development of policy-based network management technologies for real-time network response to changes in INFOCON levels. Designed					

### UNCLASSIFIED

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602702F: Command Control and Communications	I	<b>PROJECT</b> 624519: Co	ommunicatior	<i>IY</i>	
B. Accomplishments/Planned Program (\$ in Millions)	,					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>and developed network operations and security capability to p cross domain, heterogeneous network quality of performance, management. Initiated development of small hand-held multi-covert network radios. Developed a resilient and self-regener. Warfare enterprise that dynamically recognizes, characterizes and service anomalies, aids in the creation of synthetically div and continuously monitors, reconfigures, and self optimizes th attacks. Initiated development of secure data sharing to preve to untrustworthy users.</li> <li><i>FY 2010 Plans:</i> In FY 2010: Not Applicable.</li> <li><i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.</li> <li><i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.</li> </ul>	security, configuration, and fault data rate, internet protocol compatible, ating information Network Centric , and understands novel cyber attacks erse, functionally equivalent software, e mission critical enterprise to resist new					
MAJOR THRUST: Develop improved, higher bandwidth communitechnologies to provide secure, adaptive, covert, anti-jam, and ass		3.593	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Completed development of quantum key distribut effect ultra-secure communications for wired and wireless net assured access anti-jam communications capability that comb frequency, coding, polarization) transmission techniques, mult techniques, and spectrum sense and adapt techniques. Deve	works. Designed and demonstrated ines multi-dimensional (space, time, i-frequency, multi-wavelength, multi-path					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602702F: Command Control an Communications	nd	<b>PROJECT</b> 624519: Co	ommunicatio	ду	
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
and bandwidth management technologies to move, manage, a the warfighter.	and process information in real-time for					
FY 2010 Plans: In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.						
MAJOR THRUST: Develop critical information transmission techn of aerospace weapon systems' networks.	ologies to permit the seamless integration	4.153	0.000	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Completed exploring multiple technologies/techn frequency filtering to reduce overall radio frequency compone losses applicable to battlefield network operations. Conducte Compact Laser Terminal for Airborne Network Centric Warfar comsumption wavelenght tunable laser transmitter for free-spi airborne network.	nt equipment size, weight, and signal d the Congressionally-directed e effort to develop acompact, low power					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602702F: Command Control an Communications	nd	<b>PROJECT</b> 624519: Co	ommunication	nmunications Technology			
B. Accomplishments/Planned Program (\$ in Millions)	'		1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.								
MAJOR THRUST: Develop cyber operations technologies for ena communications, and intelligence.	abling worldwide command, control,	16.831	0.000	0.000	0.000	0.000		
FY 2009 Accomplishments: In FY 2009: Initiated work in Cyber Command and Control for cyber awareness and understanding. Developed defensive to embedded systems. Conducted assured end-to-end Quality integration to the information system enterprise doing malicio work in autonomic defensive response to rapidly recover from information system access methods. Initiated efforts to propa Developed stealth and persistence technologies enabling net locations, and data exfiltration/infiltration. Conducted cyber in cyber situational awareness and understanding. Conducted of integration technology development and initiated efforts for cy effects. Conducted the Congressionally-directed Cyber Attac	echniques for wireless, mobile, and of Service and Quality of Assurance us and non-malicious faults. Initiated n adversary cyber attacks. Developed agate through adversary networks. work discovery, propagation to new ntelligence gathering efforts to achieve cyber and traditional kinetic weapon yber delivery to influence operations							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.								
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.								
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.								
Acco	omplishments/Planned Programs Subtotals	34.275	0.000	0.000	0.000	0.000		

Exhibit R-2A, RDT&E Project Ju	ustification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET AC</b> 3600: <i>Research, Development, To</i> BA 2: <i>Applied Research</i>		, Air Force		R-1 ITEM N PE 0602702 Communica	F: Comman		d	<b>PROJECT</b> 624519: Co	ommunicatio	ns Technolo	gy
B. Accomplishments/Planned F	Program (\$ in N	<u>illions)</u>	I					1			
							FY 2009	FY 2010			
							1.596	0.000			
Congressional Add: Space Qual	ification of the C	ommon Dat	a Link.								
FY 2009 Accomplishments: In FY 2009: Conducted the	Congressionally	-directed Sp	ace Qualific	cation of the	Common Da	ta Link.					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
				Congre	essional Add	s Subtotals	1.596	0.000			
C. Other Program Funding Sum	nmary (\$ in Mill	ions)									
<u></u>	<u></u>		FY 2011	FY 2011	FY 2011					Cost To	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>		Complete	
• PE Not Provided (13327): Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
<b>D. Acquisition Strategy</b> Not Applicable.											
E. Performance Metrics											
Please refer to the Performance Force performance goals and m					Air Force r	esources are	applied an	d how those	resources a	re contribut	ng to Air

Exhibit R-2A, RDT&E Project Jus	tification: PE	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIN 3600: Research, Development, Tes BA 2: Applied Research		n, Air Force		R-1 ITEM N PE 0602702 Communica			nd	PROJECT 624594: Inf			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
624594: Information Technology	30.804	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### <u>Note</u>

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 systems technologies provide affordable, innovative, secure, net-enabled embedded information systems to the warfighter.

### B. Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop innovative multi-sensor collaborative fusion technologies in a fully distributed air and space environment.	6.485	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Evaluated fusion management and advance the state-of-the-art in track-to-track fusion techniques. Completed the process of probabilistic identification through 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. Completed the development of techniques to dynamically update advanced reasoning fusion engines to adapt to changing threat conditions.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602702F: Command Control an Communications	nd	PROJECT 624594: Ini	formation Teo		
B. Accomplishments/Planned Program (\$ in Millions)	I		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Completed the development and assessment of intelligence, s management techniques that optimize the fusion process for in of military significant threats. Completed the development and approaches to provide distributed fusion techniques to the wat that combine traditional kinematic associations with multi-INT and track life times of ground moving targets; taking into accor- target environments, and large sensor data inaccuracies. Cor- algorithms that can automatically develop, reason, and dynam existing intelligence preparation of the battlespace products (e of action, units, infrastructure areas, lines of communication). space information through machine-to-machine automatic fusi- resulting in a single network centric operational picture. Proce- machine automated multi-INT fusion, long-term automated tra automated/adaptive pattern recognition. Investigated Fusion of	dentification and continuous tracking d assessment of network centric fighter. Developed new track algorithms reasoning to improve the identification unt the limitations of gap times, dense npleted the development of a set of ically update various sub-sets of the e.g., named areas, target areas, courses Developed fused air, ground, and on and dynamic re-tasking processes esses examined include machine-to- cking and ID of nominated targets, and					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.						
MAJOR THRUST: Develop higher-level fusion and the enabling in	formation/knowledge base technologies	8.651	0.000	0.000	0.000	0.00

APPROPRIATION/BUDGET ACTIVITY       R-1 ITEM NOMENCLATURE         3600: Research, Development, Test & Evaluation, Air Force       PE 0602702F: Command Control and Communications         BA 2: Applied Research       FY 2009 Accomplishments/Planned Program (\$ in Millions)         FY 2009 Accomplishments:       In FY 2009: Completed 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. Developed inferencing techniques for reasoning about the situation and for predicting enemy intent and threat possibility. Developed multi-source and automated recognition techniques to support analysis of current situations. Developed 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 ISR defense on wired networks to perform an adaptive response to multiple. COAs having cascading effects in near real-time. The capability mixes 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 maker's ability to appraise and plan the "best" blue course of action for Rapid, Decide, Act, and Adapt. Completed 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).			oruary 2010	
FY 2009 Accomplishments: In FY 2009: Completed 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. Developed inferencing techniques for reasoning about the situation and for predicting enemy intent and threat possibility. Developed multi-source and automated recognition techniques to support analysis of current situations. Developed 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 ISR defense on wired networks to perform an adaptive response to multiple, coordinated, and sustained attacks. Conducted research to achieve the capability to analyze multiple COAs having cascading effects in near real-time. The capability mixes 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. Conducted 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. Completed 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	<b>PROJECT</b> 624594: <i>In</i>	echnology		
<i>FY 2009 Accomplishments:</i> In FY 2009: Completed 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. Developed inferencing techniques for reasoning about the situation and for predicting enemy intent and threat possibility. Developed multi-source and automated recognition techniques to support analysis of current situations. Developed 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 ISR defense on wired networks to perform an adaptive response to multiple, coordinated, and sustained attacks. Conducted research to achieve the capability to analyze multiple COAs having cascading effects in near real-time. The capability mixes 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. Conducted 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. Completed 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	1			
In FY 2009: Completed 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. Developed inferencing techniques for reasoning about the situation and for predicting enemy intent and threat possibility. Developed multi-source and automated recognition techniques to support analysis of current situations. Developed 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 ISR defense on wired networks to perform an adaptive response to multiple, coordinated, and sustained attacks. Conducted research to achieve the capability to analyze multiple COAs having cascading effects in near real-time. The capability mixes 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. Conducted 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. Completed 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	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans: In FY 2010: Not Applicable.</li> <li>FY 2011 Base Plans: In FY 2011: Not Applicable.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: Not Applicable.</li> </ul>				

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602702F: Command Control at Communications	nd	PROJECT 624594: Inf	ormation Tec		
B. Accomplishments/Planned Program (\$ in Millions)	'		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop automatic and dynamically reconfigura petaflop processing technologies for real-time global information s		6.656	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Implemented architectural features for cognitive in algorithm development for next generation information technol architectural development for cognitive information processing characterization of high performance computers for quantum of characterized the next generation of high performance compute prototype chip that contains a hybrid architecture design, which large-scale cognitive architecture evaluations. Conducted the standards, and technologies required to build highly complex so development of high capacity processing on demand, which w of raw data to actionable information. Provided hardware and complex software to be readily composed.	ogies for C2 systems. Completed . Completed development and computing applications. Developed and ters. Completed the development of a h will provide an emulation capability for development of the tools, techniques, software-intensive systems. Initiated ill reduce the ever increasing amounts					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.						
MAJOR THRUST: Develop modeling and simulation technologies		2.146	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602702F: Command Control ar Communications	nd	<b>PROJECT</b> 624594: In	formation Te		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Completed demonstrations of adversarial behaviling for courses of action assessment and prediction. Conducted interaction and assessment of friendly versus adversary courses of a prototypical dynamic situation assessment and prediction concepts to provide approaches for a modeling toolset that error simulations. Investigated the ability to forecast potential advect of known evidence and projected known and/or anticipated the FY 2010 Plans:</li> <li>In FY 2010 Plans:</li> <li>In FY 2011: Not Applicable.</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: Not Applicable.</li> </ul>	concept demonstrations of integrated ses of action. Completed demonstration n system. Investigated advanced nables the warfighter to build composable ersaries and events based on indications					
MAJOR THRUST: Develop real-time embedded information syste embedded systems to enable affordable design and development		1.848	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Completed development of dynamically reconfig adaptive computing techniques to support image/video proces development of affordable, high assurance components for re MLS/MSLS and mixed criticality. Completed development of processes using biologically-inspired and biologically-based of application. Completed development of power-aware, polymo aware computing.	ssing and data compression. Completed eal-time embedded systems supporting methods of computation and computing computation for embedded systems					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602702F: Command Control ar Communications	<b>PROJECT</b> 624594: Information Technology				
B. Accomplishments/Planned Program (\$ in Millions)	· ·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable. <i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.						
MAJOR THRUST/CONGRESSIONAL ADD: Develop digital informate electronic communications and special signals intelligence, imagery <i>FY 2009 Accomplishments:</i> In FY 2009: Developed the multi-intelligence processing, explo- intelligence. Completed the development of more effective mul- algorithms to enhance detection (by 50%), identification (by 25% analyst time) of difficult targets; taking into account the completer physical, materials) that can be derived from multiple MASINT st to automatically detect and identify audio protection and channed personal communications systems with the goal of providing and detect speech privacy and identify methods and means used. I and mechanisms to achieve robust/tamper-proof self-authentica and detection and eradication systems for polymorphic malware and prevention of embedded malicious software (malware), syst recovery, and the development of self-correcting watermarked of computing.	, and measurement signatures. itation, and dissemination of actionable ti-sensor signature exploitation %), and assessment (10X reduction in nentary signature features (e.g., geo- sensors. Completed the development elization effects in modern modulated alysts the capability to automatically nitiated development of methods ating, self-regenerating code/data e. Research included the detection item self-optimization/diagnosis/	5.018	0.000	0.000	0.000	0.000
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010				
<b>PPROPRIATION/BUDGET ACT</b> 600: Research, Development, Te A 2: Applied Research		, Air Force		R-1 ITEM NO PE 0602702 Communicat	F: Comman	-	d	PROJECT 624594: Inf	<b>T</b> nformation Technology			
. Accomplishments/Planned P	rogram (\$ in M	lillions)						1				
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.												
FY 2011 OCO Plans: In FY 2011 OCO: Not Applica	able.											
			Accomplish	ments/Plann	ed Program	s Subtotals	30.804	0.000	0.000	0.000	0.00	
. Other Program Funding Sum Line Item	FY 2009	FY 2010	<u>FY 2011</u> <u>Base</u>	<u>FY 2011</u> <u>OCO</u>	<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>		-	
PE Not Provided (13550): Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	
. Acquisition Strategy Not Applicable.												
<u>. Performance Metrics</u> Please refer to the Performance	Base Budget C			ation on how our mission.	Air Force re	esources are	e applied an	d how those	resources a	re contributi	ng to Air	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Tes BA 2: Applied Research	Iopment, Test & Evaluation, Air Force PE 0602702F: Command Control and				<b>PROJECT</b> 625581: Command and Control (C2) Technology						
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
625581: Command and Control (C2) Technology	38.385	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### <u>Note</u>

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 command and control 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Investigate and develop technologies for the rapid development and application of next generation knowledge bases for aerospace C2 systems.	5.177	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: 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-					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	)		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	R-1 ITEM NOMENCLATUREPROJECTPE 0602702F: Command Control and625581: CCommunicationsTechnology			Command and Control (C2)				
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
world requiring intelligence. Investigated and developed special self-aware, learning agents that can generate well-focused knot extraction, correlation, and classification of link patterns for disc entities.	wledge bases for automated intelligent							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.								
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.								
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.								
MAJOR THRUST: Investigate, analyze, and develop technologies distributed intelligent information systems to varying crisis levels.	for automatic rapid reconfiguration of	10.518	0.000	0.000	0.000	0.000		
FY 2009 Accomplishments: In FY 2009: Developed advanced interactive displays suitable environments with C2 applications and command centers. Dev based applications for information visualization for use in conju data sets. Developed technologies to improve the fidelity, accu computer-based wargames used to prepare contingency plans technologies for a holistic tool set that commanders can use to reason, and predict activities in the battlespace. Developed can net centric enabled environment. Conducted the development and coordination capabilities that account for uncertainty and n supports intuitive decision making process between man and n dynamic problems exploiting the respective strengths of machin	veloped advanced techniques and AOC- inction with multiple, heterogeneous uracy, and interconnection of and response strategies. Developed probe, study, analyze, visualize, pabilities to be more agile within a of timely option generation selection hissing and erroneous information and nachine collaborating on complex,							

<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Air Force <b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602702F: Command Control an Communications	0602702F: Command Control and 625581: (			: Command and Control (C2)		
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
(analytical reasoning). Developed dynamic workflow and wor manage the command and control constellation of resources.	kload management capabilities to						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
FY 2011 OCO Plans: In FY 2011 OCO: Not Applicable.							
MAJOR THRUST: Investigate and develop technologies to secur subscribe, and query with coalition partners as part of the Global I		7.036	0.000	0.000	0.000	0.00	
FY 2009 Accomplishments: In FY 2009: Completed cross-domain information sharing rescollaborative monitoring and management of multi-national ere techniques and tools that will ensure availability, integrity, and coalition net-centric environment. Investigated technologies, information in a coalition environment and assess the trustwo be shared throughout the coalition. Investigated and prototyp and information management technologies such as fuselets to across a multi-domain enterprise into fused events. Developed for application to a CBDN system for intelligent network management	nterprise resources. Developed d survivability of information within a which can determine the pedigree of rthiness of the marked up information to bed the application of information fusion o extend composite views of events ed publish/subscribe/query technologies						
FY 2010 Plans: In FY 2010: Not Applicable.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	PE 0602702F: Command Control and 62558			<b>PROJECT</b> 525581: Command and Control (C Fechnology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Not Applicable.						
FY 2011 OCO Plans: In FY 2011 OCO: Not Applicable.						
MAJOR THRUST: Develop next generation monitoring, planning, execution, and assessment technologies and tools.			0.000	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Investigated application of decision support scien concepts to C2 activities within a coalition AOC. Developed in supporting joint/coalition C2 for various missions in a dynamic tools to increase situational awareness and understanding the Conducted the application of system-of-systems and federation creation of joint C2 capabilities. Explored the application of in battle staff members to enhance various C2 processes. Deve analysis for effects attainment at all levels of a campaign, linki undesirable effects. The capability utilizes causal reasoning, I state, develops non-deterministic, non-linear causal linkages, uncertainty and ambiguity.	ntelligent information systems capable of cally changing environment. Developed ough intelligent information processing. on-of-systems engineering in the telligent software agents as virtual eloped capability for a full-spectrum ing leading indicators to desired and linking effects to actions to desired end-					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602702F: Command Control an Communications	nd	PROJECT 625581: Co Technology		nmand and Control (C2)		
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 OCO Plans: In FY 2011 OCO: Not Applicable.							
MAJOR THRUST: Investigate and develop technologies to impler scalable, and survivable information management and disseminat		2.008	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Developed high-payoff publish, subscribe, and q higher levels of performance, security, and scalability capable support Air Force net-centric environment needs. Developed COI Infospheres at various levels of security classification. In for dynamically evolving the net-centric environment so as to exploiting information technologies based on quality of service information services across operational boundaries and dissir Developed information transformation services and adaptive i learn, self-configure, self-manage, and are self-healing.	of exceeding commercial products and the security policy enforcement between vestigated methods and techniques avoid system crashes or latency by e mechanism. Initiated integration of nilar infrastructure based systems.						
FY 2010 Plans: In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.							
MAJOR THRUST: Develop distributed collaboration technologies		6.514	0.000	0.000	0.000	0.000	

Exhibit R-2A, RDT&E Project Just	ification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIV</b> 3600: Research, Development, Test BA 2: Applied Research		, Air Force		<b>R-1 ITEM NO</b> PE 0602702 Communicat	F: Comman	-	d	PROJECT 625581: Command and Control (C2) Technology				
B. Accomplishments/Planned Pro	gram (\$ in M	illions)										
		-					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2009 Accomplishments: In FY 2009: Completed develo making and knowledge manage planning, execution, and assess environment technologies for ac Global Strike Concept of Opera on demand that will exploit dyna phones, etc.) with appropriate in interfaces and semantic interop</li> <li>FY 2010 Plans: In FY 2010: Not Applicable.</li> <li>FY 2011 Base Plans: In FY 2011: Not Applicable.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO Plans: In FY 2011 OCO: Not Applicable</li> </ul>	ement in supp sment environ dvanced deci ations and ope amic informat nformation fo berability.	oort of capat nments. Co sion support erations othe ion services	bility-based p mpleted prot t for high-pro er then war. matching er	planning and totyping distr file system of Studied colla nd user device	next genera ibuted collal concepts, su aboration se ces (laptops	tion oorative ch as the rvices cell						
			Accomplish	ments/Plann	ed Program	s Subtotals	38.385	0.000	0.000	0.000	0.000	
C. Other Program Funding Summa	ary (\$ in Milli	ions)								<b>.</b> . <b>.</b>		
Line Item • PE Not Provided (13773): Activity Not Provided	<u>FY 2009</u> 0.000	<b>FY 2010</b> 0.000	FY 2011 Base 0.000	FY 2011 OCO 0.000	<u>FY 2011</u> <u>Total</u> 0.000	FY 2012 0.000	<u>FY 2013</u> 0.000	<u>FY 2014</u> 0.000	<b>FY 2015</b> 0.000	Cost To Complete 0.000	<u>Total Cost</u> 0.000	
• PE 0603617F: C3 Applications.	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	

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Exhibit R-2A, RDT&E Project Justif	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVI</b> 3600: Research, Development, Test & BA 2: Applied Research		, Air Force		R-1 ITEM NO PE 0602702 Communicati	<b>PROJECT</b> 625581: Command and Control (C2) Technology						
C. Other Program Funding Summa	ry (\$ in Milli	ions)		1				1			
Line Item • PE 0303401F: Communications- Computer Systems (C-CS) Security RDT&E.	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u> <u>Base</u>		<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Cost To</u> Complete	
D. Acquisition Strategy Not Applicable. E. Performance Metrics Please refer to the Performance Ba					Air Force r	esources are	applied an	d how those	resources a	re contribut	ing to Air
Force performance goals and most											

Exhibit R-2A, RDT&E Project Jus	chibit R-2A, RDT&E Project Justification: PB 2011 Air Force							DATE: February 2010			
	PPROPRIATION/BUDGET ACTIVITY 00: Research, Development, Test & Evaluation, Air Force 2: Applied Research			<b>R-1 ITEM NOMENCLATURE</b> PE 0602702F: Command Control and Communications				<b>PROJECT</b> 6266SP: Space Optical Network Tech			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
6266SP: Space Optical Network Tech	9.450	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

<u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and assess optical network technologies for application in the space environment.	2.815	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Developed 40 channel multi wavelength optical network for on-board air and space applications.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			,	DATE: Febr	uary 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602702F: Command Control a Communications	602702F: Command Control and 6266SP:				<b>T</b> Space Optical Network Tech			
B. Accomplishments/Planned Program (\$ in Millions)	I		1						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.									
FY 2011 Base Plans: In FY 2011: Not Applicable.									
FY 2011 OCO Plans: In FY 2011 OCO: Not Applicable.									
MAJOR THRUST: Develop and assess existing and emerging Op schemes and protocols for use in space-based optical networks.	otical CDMA and WDM modulation	1.705	0.000	0.000	0.000	0.00			
FY 2009 Accomplishments: In FY 2009: Initiated flight demonstration of multi-gigabit, mul bus interface chip for space and air platforms.	ti-wavelength optical communications								
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.									
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.									
FY 2011 OCO Plans: In FY 2011 OCO: Not Applicable.									
MAJOR THRUST: Develop and demonstrate heterogeneous, sea capacity air/space/surface wireless networks.	mless, secure, self-configuring high	4.930	0.000	0.000	0.000	0.00			

Exhibit R-2A, RDT&E Project J	ustification: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET AC</b> 3600: Research, Development, T BA 2: Applied Research		, Air Force						PROJECT 6266SP: S	pace Optical Network Tech			
B. Accomplishments/Planned I	Program (\$ in M	lillions)										
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2009 Accomplishments: In FY 2009: Completed the waveform data link technolo an integrated RF/laser comr	gy for operation	under adver	rse weather	conditions.								
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.												
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.												
FY 2011 OCO Plans: In FY 2011 OCO: Not Applic	cable.											
			Accomplish	ments/Planr	ned Program	s Subtotals	9.450	0.000	0.000	0.000	0.00	
C. Other Program Funding Sun	nmary (\$ in Mill	ions)										
Line Item • PE Not Provided (13930): Activity Not Provided	<u>FY 2009</u> 0.000	<u>FY 2010</u> 0.000	FY 2011 Base 0.000	FY 2011 OCO 0.000	<u>FY 2011</u> <u>Total</u> 0.000	FY 2012 0.000	FY 2013 0.000		<u>FY 2015</u> 0.000	<u>Cost To</u> <u>Complete</u> 0.000		
<b>D. Acquisition Strategy</b> Not Applicable.												
E. Performance Metrics Please refer to the Performance Force performance goals and m					v Air Force re	esources are	e applied ar	id how those	resources a	re contributi	ng to Air	

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Exhibit R-2, RDT&E Budget Item	Justification	: PB 2011 A	ir Force						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information Technology</i>							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	0.000	116.785	117.283	0.000	117.283	129.320	131.538	134.298	136.922	Continuing	Continuing
625315: Connectivity and Protection Tech	0.000	46.429	46.780	0.000	46.780	53.093	53.432	54.110	54.869	Continuing	Continuing
625316: Info Mgt and Computational Tech	0.000	33.674	30.804	0.000	30.804	32.506	32.266	34.769	35.617	Continuing	Continuing
625317: Information Decision Making Tech	0.000	16.869	18.835	0.000	18.835	17.962	18.696	20.325	20.394	Continuing	Continuing
625318: Operational Awareness Tech	0.000	19.813	20.864	0.000	20.864	25.759	27.144	25.094	26.042	Continuing	Continuing

#### <u>Note</u>

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 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 Information Decision Making Tech project develops the technology necessary to support the commander and staffs ability to command all viable options to achieve desired effects across the full spectrum of operations. 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. This program is in Budget Activity 2, since it develops and demonstrates the technical feasibility and military utility of evolutionary and revolutionary technologies

bit R-2, RDT&E Budget Item Justification: PB 2011 Air	Force			DATE:	February 2010	
<b>ROPRIATION/BUDGET ACTIVITY</b> Research, Development, Test & Evaluation, Air Force Applied Research		<b>EM NOMENCLA</b> 02788F: <i>Domina</i>	<b>NTURE</b> Int Information Technolo	gy		
ogram Change Summary (\$ in Millions)						
	<u>FY 2009</u>	<u>FY 2010</u>	FY 2011 Base	FY 2011 OCO	<u>FY 2011</u>	Total
Previous President's Budget	0.000	115.278	0.000	0.000	(	0.000
Current President's Budget	0.000	116.785	117.283	0.000	11	7.283
Total Adjustments	0.000	1.507	117.283	0.000	11	7.283
<ul> <li>Congressional General Reductions</li> </ul>		0.000				
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000				
<ul> <li>Congressional Rescissions</li> </ul>	0.000	-0.493				
<ul> <li>Congressional Adds</li> </ul>		2.000				
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000				
<ul> <li>Reprogrammings</li> </ul>	0.000	0.000				
<ul> <li>SBIR/STTR Transfer</li> </ul>	0.000	0.000				
Other Adjustments	0.000	0.000	117.283	0.000	11	7.283
Congressional Add Details (\$ in Millions, and Includ	es General Redu	uctions)		[	FY 2009	FY 20 <sup>-</sup>
Project: 625315: Connectivity and Protection Tech						
Congressional Add: Efficient Utilization of Transmis	sion Hyperspace				0.000	1
		Cong	ressional Add Subtotals	s for Project: 625315	0.000	1
			Congressional Add 7	Totals for all Projects	0.000	1
Change Summary Explanation Note: In FY 2010, Congress added \$2.0 million for Efficient						

manner.

C. Performance Metrics Under Development.

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Exhibit R-2A, RDT&E Project Ju	xhibit R-2A, RDT&E Project Justification: PB 2011 Air Force							DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research								<b>PROJECT</b> 625315: <i>Connectivity and Protection Tech</i>			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	46.429	46.780	0.000	46.780	53.093	53.432	54.110	54.869	Continuing	Continuing

#### <u>Note</u>

Note: Prior to FY 2010, efforts in this PE were performed in PE 0602702F, Command, Control and Communications, Projects 4519 and 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, and 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 communications techniques; agile, dynamic policy based network management capabilities; and modular, programmable, low-cost software radios. This project also develops both the technologies for implementing photonic chip scale optical Code Division Multiple Access (CDMA) and Wavelength Division Multiplexed (WMD) transceivers and prototype networks associated with advanced fiber optics 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 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 Air Force commanders.

#### B. Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop assured and survivable information and networking technologies enabling worldwide command, control, surveillance, reconnaissance, and exploitation operations.	0.000	6.983	10.473	0.000	10.473

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	PE 0602788F: Dominant Information 62531			nd Protectior	n Tech
B. Accomplishments/Planned Program (\$ in Millions)	· · · ·		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2009 Accomplishments: In FY 2009: Not Applicable.</li> <li>FY 2010 Plans: In FY 2010: Initiate development of low probability of intercept for hand held multi data rate radio. Design smart power contrigate arrays with reduced size, weight, and power for hand held development of a resilient and self-regenerating information e characterizes, and understands novel cyber attacks and servit synthetically diverse, functionally equivalent software, and cor self optimizes the mission critical enterprise to resist new attacted.</li> <li>FY 2011 Base Plans: In FY 2011: Complete development of low probability of interview aveform for hand held multi data rate radio. Complete development of a resilient enterprise to resist new attacted and reachback capability. Complete design of soldier interfact and advanced field programmable gate arrays with reduced sheld multi data rate radio. Continue development of a resilient enterprise that dynamically recognizes, characterizes, and unservice anomalies, aids in the creation of synthetically diverses continuously monitors, reconfigures, and self optimizes the mit attacks. Develop capability to enhance trust within airborne n</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	ol and advanced field programmable d multi-data rate radio. Continue nterprise that dynamically recognizes, ce anomalies, aids in the creation of ntinuously monitors, reconfigures, and cks. cept, and low probability of detection lopment of small form-factor networking to integrate smart power control ize, weight, and power for hand t and self-regenerating information derstands novel cyber attacks and a, functionally equivalent software, and ission critical enterprise to resist new					
MAJOR THRUST: Develop improved, higher bandwidth communi technologies to provide secure, adaptive, covert, anti-jam, and ass		0.000	6.200	3.295	0.000	3.295

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information</i> <i>Technology</i>	1	<b>PROJECT</b> 625315: Connectivity and Protection Tech			Tech
B. Accomplishments/Planned Program (\$ in Millions)			·			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2009 Accomplishments: In FY 2009: Not Applicable.</li> <li>FY 2010 Plans: In FY 2010: Design and demonstrate an automated reasoning system based on semantic web technologies capable of reaso detected network events rather than presenting only raw data demonstration of assured access, anti-jam communications ca (space, time, frequency, coding) transmission techniques to m interference, and jamming environments via spectrum sense a design and demonstration of cognitive networking technology discerns application requirements, and adapts network protoco of advanced, automated, wireless airborne networking and con for the assessment and evaluation of communications algorith environment. Initiate in-house and university development of technologies for distributed military operations in an airborne e exchange across all domains of air, space, and cyber.</li> <li>FY 2011 Base Plans: In FY 2011: Continue in-house and university development of technologies for distributed military operations in an airborne e exchange across all domains of air, space, and cyber. Develop wireless protocols for use in the unmanned air vehicle environ bandwidth to a variety of airborne platforms with varying data of FY 2011 OCO Plans: In FY 2011 OCO Plans: In FY 2011 OCO Plans:</li> </ul>	ining out suggested conclusions to to an information manager. Complete apability that combines multi-dimensional itigate and survive in multipath fading, and adapt techniques. Complete that senses operational environment, ols/resources. Complete development mmunications link emulation capability ms in a virtual military communications next generation advanced networking environment ensuring reliable information of next generation advanced networking environment ensuring reliable information p capability to enhance leading ment. Develop capability for increased			7.001		
		0.000	1.623	7.201	0.000	7.201

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	n	<b>PROJECT</b> 625315: Co	<b>ECT</b> 5: Connectivity and Protection Tech				
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
MAJOR THRUST: Develop cyber defense and supporting technolog attacks on computer systems as well as provide forensic analysis co								
FY 2009 Accomplishments: In FY 2009: Not Applicable.								
FY 2010 Plans: In FY 2010: Continue to develop defensive techniques for wirel systems. Initiate vulnerability analysis and threat identification f standards. Complete investigation of fusion of cyber intelligenc methods (INTs) and use of CybINT collection technologies to in enterprise systems and malicious activities occurring therein. C demonstration plans for cyber situational awareness and unders cooperative agents under positive control to defend mission crit of technology demonstration plans for active intelligence, survei defense on wired networks to perform an adaptive response to attacks.	For emerging commercial wireless e (CybINT) with traditional intelligence crease situational awareness of Continue development of technology standing using an autonomous set of ical AF assets. Initiate development Ilance, and reconnaissance (ISR)							
FY 2011 Base Plans: In FY 2011: Continue to develop defensive techniques for wirele Initiate vulnerability analysis and threat identification for emergin Continue development of technology demonstration plans for in technologies to provide improved security of operating systems critical AF assets. Develop root of trust techniques for the prote- laterally within a network and vertically within a network enclave. Develop hardware and software techniques to operating systems in order to be invisible to potential cyber atta rules of engagement (ROE). Develop formal models for cyber of deconflict policies generated by a diverse set of stakeholders an	ng commercial wireless standards. plementing enhanced cyber security against cyber attacks against mission ction of digital devices and data both enhance the security of traditional cks and effectively implement cyber defense policies with the ability to							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	n	<b>PROJECT</b> 625315: <i>Connectivity and Pro</i>			Protection Tech	
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
cyber indications and warning (I&W) and ROE. Develop tech attacks of AF networks/systems and perform damage assess Develop cyber forensic techniques that allow AF personnel to attacks on AF cyber infrastructure. FY 2011 OCO Plans:	nents of successful adversary attacks.						
In FY 2011 OCO: N/A							
MAJOR THRUST: Develop offensive cyber operations technologie deliver effects to adversary systems.	es to access, maintain presence on, and	0.000	15.246	12.266	0.000	12.26	
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Continue development of information system acc propagation techniques. Continue development of stealth and development of the capability to exfiltrate information from adv generation of actionable CybINT. Continue technology develop and increased situational awareness and understanding. Con deliver D5 (deceive, deny, disrupt, degrade, and destroy) effect technologies for operating within adversary information system for covert communication among agents operating within adver analysis of proprietary hardware and software systems to iden sustained operations within the same. Initiate efforts to develop and exfiltration of information while operating within adversary ability to identify foreign languages as a part of a CybINT capa	I persistence technologies. Initiate versary information systems for opment for preparation of the battlefield tinue development of technology to cts. Initiate efforts to develop autonomic ns. Initiate development of techniques ersary information systems. Initiate tify viable means of access and op a pub/sub architecture for exchange information systems. Demonstrate						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	n	<b>PROJECT</b> 625315: Co	nnectivity ar	nd Protection	n Tech	
B. Accomplishments/Planned Program (\$ in Millions)	· ·		1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 Base Plans: In FY 2011: Continue development of information system accord propagation techniques. Continue development of stealth and development of the capability to exfiltrate information from adv generation of actionable CybINT. Continue technology develop and increased situational awareness and understanding. Con- deliver D5 effects. Continue development of autonomic technor information systems. Continue development of techniques for operating within adversary information systems. Continue and software systems to identify viable means of access and susta Continue development of a publish/subscribe architecture for ev while operating within adversary information systems. Initiate of PsyOps via cyber channels. Develop deception techniques to adversary attempts to probe and infiltrate AF systems.	persistence technologies. Continue resary information systems for opment for preparation of the battlefield tinue development of technology to ologies for operating within adversary covert communication among agents alysis of proprietary hardware and nined operations within the same. exchange and exfiltration of information development of techniques to deliver						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Investigate the range of cyber technologies as dominance.	needed to achieve information and cyber	0.000	5.159	3.681	0.000	3.681	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Initiate development of technologies to support a avoids exposure to threats and can proactively escape from in friendly information systems. Initiate development of technique maneuvers in cyberspace. Initiate development of technology	coming threats before they affect es to support evasion and escape						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information</i> <i>Technology</i>		<b>PROJECT</b> 625315: Co	onnectivity ar	d Protection	Tech
B. Accomplishments/Planned Program (\$ in Millions)						
	F	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
information system hardware resources. Initiate the development of thin client technology to protect end user information systems from challenge problem and university research investigations for develo supporting AF information systems.	network-delivered threats. Initiate					
FY 2011 Base Plans: In FY 2011: Continue development of polymorphic cyber technologies to support a polymorphic cyber infrastructure that a can proactively escape from incoming threats before they affect frie Continue challenge problem and university research investigations capabilities supporting AF information systems. Complete the development of the character of the character of the continue that a conther in a rapid, synchronized and secure manner. Init an effects-based strategic approach to cyber defense that focuses development of technical means to render adversary cyber capabilities introducing fundamental information assurance (IA) mechanisms in a code transformation tool to thwart malicious code attacks, thus recompletely ineffective. Initiate development of a code transformation attacks.	avoids exposure to threats and endly information systems. for development of cyber domain elopment of remote rendering systems from network-delivered v shift systems from one address iate work to define and develop on avoiding the threat. Initiate lities irrelevant and ineffective by no systems. Initiate development of endering adversary cyber weapons					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop methods and technologies for controlled or during attacks and fault conditions, and for guaranteeing the correctnes		0.000	2.043	2.709	0.000	2.709
FY 2009 Accomplishments: In FY 2009: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	า	<b>PROJECT</b> 625315: Co	PROJECT 625315: Connectivity and Protection Tech			
B. Accomplishments/Planned Program (\$ in Millions)	1		1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2010 Plans: In FY 2010: Initiate development of assured end-to-end quality information assurance (QoIA) integration to the information syst the ability to degrade gracefully in a controlled trade space. Init protection techniques to guarantee the incorruptibility of data an</li> <li>FY 2011 Base Plans: In FY 2011: Complete development of assured end-to-end QoS information system during attacks and faults to provide the abilit trade space. Continue development of novel anti-tamper softwat the incorruptibility of data and executable codes. Initiate development to increase system survivability while under a cyber attack. Demalicious modifications to mission-critical data.</li> </ul>	tem during attacks and faults to provide tiate development of novel software nd executable codes. S and QoIA integration to the ity to degrade gracefully in a controlled are protection techniques to guarantee opment of defensive cyber technologies						
FY 2011 OCO Plans: In FY 2011 OCO: N/A							
MAJOR THRUST: Develop and assess optical network technologie environment.	es for application in the space	0.000	4.818	3.586	0.000	3.586	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Design and develop a flight test system with a Der (DWDM) broadcast architecture consisting of an optical backbo cable, tunable laser transmitters, 32 channel receivers, a passiv connectors. Continue development of 40 channel multi wavele and space applications.	one with single mode fiber optic ve star coupler, and expanded beam						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	า	<b>PROJECT</b> 625315: Co	onnectivity an	nd Protection Tech		
B. Accomplishments/Planned Program (\$ in Millions)	· · · · · ·						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 Base Plans: In FY 2011: Install the flight test system in a tactical avionics pla complete in-flight verification of the DWDM single mode system times and latency, total throughput, reconfigurability, bit error rat switching during flight operations. Complete development of 40 network for on-board air and space applications.	by testing data integrity, switching tes, and wavelength						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Design and develop flight ready systems consisti components and architectures for next generation platform communi		0.000	2.365	3.569	0.000	3.569	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Complete characterization of higher throughput RF Initiate development of prototype hardware and software with ac modulation for higher throughput RF waveform generation.							
FY 2011 Base Plans: In FY 2011: Complete the fabrication of several flight test ready Conduct flight testing. Complete ground tests of RF waveform g capacity persistent sensor data transmission. Complete the fab software for higher throughput RF waveform generation. Compl ready RF waveform data link systems. Initiate development of r links supporting transmission requirements of airborne and space	generation to demonstrate high rication of prototype hardware and lete the fabrication of several flight test next generation of high capacity data						

Exhibit R-2A, RDT&E Project Just	tification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 2: Applied Research		, Air Force		<b>R-1 ITEM N</b> PE 0602788 <i>Technology</i>			1	<b>PROJECT</b> 625315: Co	nnectivity ar	nectivity and Protection Tech		
B. Accomplishments/Planned Pro	ogram (\$ in M	illions)	1					1				
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A												
			Accomplish	ments/Plann	ed Program	s Subtotals	0.000	44.437	46.780	0.000	46.780	
							FY 2009	FY 2010				
							0.000	1.992				
Congressional Add: Efficient Utiliza	ation of Transi	nission Hyp	erspace.				0.000	1.002				
FY 2009 Accomplishments: In FY 2009: Not Applicable.												
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congress Hyperspace.	sionally-direct	ed effort for	Efficient Util	ization of Tra	ansmission							
				Congre	ssional Add	s Subtotals	0.000	1.992				
C. Other Program Funding Summ	ary (\$ in Milli	<u>ons)</u>										
	E)/ 0000		<u>FY 2011</u>	FY 2011	FY 2011		E)/ 00/0	<b>EV 0044</b>		Cost To		
Line Item • PE Not Provided (14332): Activity Not Provided	FY 2009 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	<u>0C0</u> 0.000	<u>Total</u> 0.000	<u>FY 2012</u> 0.000	<u>FY 2013</u> 0.000	FY 2014 0.000	0.000	0.000	<u>Total Cost</u> 0.000	
D. Acquisition Strategy												
Not applicable.												

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force	_	DATE: February 2010	
	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information</i> <i>Technology</i>	<b>PROJECT</b> 625315: Co	onnectivity and Protection Tech

### **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, RDT&E Project Ju	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information</i> <i>Technology</i>				<b>PROJECT</b> 625316: Info Mgt and Computational Tech				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	33.674	30.804	0.000	30.804	32.506	32.266	34.769	35.617	Continuing	Continuing	

#### <u>Note</u>

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 Air Force 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 to the Air Force. It includes technology is no objectives and real-time computing improving the usability of high performance computing to the Air Force. It includes technologies in computational sciences and engineering, computer architectures, and software intensive systems.

### B. Accomplishments/Planned Program (\$ in Millions)

			FY 2011	FY 2011	FY 2011
	FY 2009	FY 2010	Base	000	Total
MAJOR THRUST: Investigate and develop technologies to securely share information via publish, subscribe, and query with coalition partners as part of the Global Information Grid (GIG).	0.000	10.433	8.670	0.000	8.670
FY 2009 Accomplishments: In FY 2009: Not Applicable.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information</i> <i>Technology</i>		PROJECT 625316: Int	o Mgt and C	omputationa	l Tech	
B. Accomplishments/Planned Program (\$ in Millions)							
	FY	Y 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Continue research into cross domain information cognitively assisted information technologies to provide autom intensive process of human review and release of sensitive im and enclaves. Develop secure cross domain discovery and sevelopment of content-based dissemination mechanisms and development of novel information management techniques as and university research leading to enhanced information flow a FY 2011 Base Plans:</li> <li>In FY 2011: Complete research efforts to improve the timeline process using advanced information from a higher classidomain, as well as to coalition partners. Various methods will comprehension, statistical analysis, and hidden content mining service authorization and discovery. Complete development or brokering for the discovery and sharing of web services. Continuangement techniques as applied to all domains through inenhanced information flow across the net-centric assets of the techniques for tamper proof systems, resilient distributed data defense of DoD COTS information systems. Develop method malicious implants over the entire supply chain caused by eith FY 2011 OCO Plans: In FY 2011 OCO Plans:</li> <li>In FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: N/A</li> </ul>	ated assistance to the current labor- formation to other security domains sharing of web services. Complete d quality of service provisioning. Initiate applied to all domains through in-house across the net-centric assets of the GIG. ess and accuracy of the human review opment of tools and safeguards required fication domain to a lower classification be explored to include machine g. Initiate research into cross domain f secure cross-domain information tinue development of novel information house and university research leading to a GIG. Develop information assurance stores and out-of-band security to allow s to evaluate commercial products for her external or internal threats.	0.000	13 819	8 755	0.000	8 75	
MAJOR THRUST: Investigate and develop technologies to impler scalable, and survivable information management and disseminati		0.000	13.819	8.755	0.000	8.75	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	<b>PROJECT</b> 625316: Inf	JECT 16: Info Mgt and Computational				
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2009 Accomplishments: In FY 2009: Not Applicable.</li> <li>FY 2010 Plans: In FY 2010: Develop service components that provide information as infrastructure components within a service oriented architectur components may be assembled to establish a robust and reliable eliminating application complexity and management responsibility and share information across disbursed locations and establish the and authoritative control over the information. Develop information share and synchronize dynamic information sources where inform and require secure disperse dissemination. Develop prioritized q value of delivered information based upon its context. Demonstration management through advanced infospherics research. Initiate d dominance capabilities that include unmanned aerial systems (U/ altitude platforms.</li> </ul>	re (SOA). Collections of the service information sharing substrate, y. Develop mechanisms to federate the means to maintain provenance on sharing mechanisms to efficiently nation changes are in the seconds ueuing mechanisms to maximize ate decentralized information levelopment of tactical information						
FY 2011 Base Plans: In FY 2011: Develop service components that provide information as infrastructure components within a SOA. Expand on the SOA to tactical airborne operations. Continue development of the mec decentralized manner between peers with any centralized policy distributed entities transparent and non-dependent on any individ of SOA substrate that will provide guaranteed levels of informatio applications based on mission based operational context and der into dynamic information management system infrastructure. Initia development to provide high performance, secure, scalable, and	techniques so they can be applied hanisms to share information in a management operating through the ual entity. Continue development n dissemination to specific user ived policy. Complete research ate nano-computer technology						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology		<b>PROJECT</b> 625316: Info Mgt and Computational Tec			l Tech
B. Accomplishments/Planned Program (\$ in Millions)	'					
	F	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Initiate quantum information sciences technology to provide e Develop information management capabilities in support of fo						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop collaborative services technologies ar development and fielding of next generation decision support syste		0.000	0.657	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Based on study results, begin development of an framework that leverages open system standards and technol that can adapt the execution of information services to the cha environments.	ogies to implement workflow capabilities					
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable. Effort eliminated due to higher <i>I</i>	Air Force priorities.					
FY 2011 OCO Plans: In FY 2011 OCO: N/A						
MAJOR THRUST: Develop automatic and dynamically reconfigure petaflop processing technologies for real-time global information s		0.000	4.082	6.707	0.000	6.70
FY 2009 Accomplishments: In FY 2009: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	n	PROJECT 625316: Int	fo Mgt and C	omputationa	l Tech	
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Continue the development of the tools, technique to build highly complex software-intensive systems. Continue processing on demand which will reduce the ever increasing a information. Provide hardware and system/support software freadily composed. Evaluate current processor functionality as system on chip capability. Initiate architectures for cognitives for modular system. Initiate scalable quantum information sci searching and processing. Develop algorithms and simulation and relevant problems. Initiate development of next generative enabling superior information processing for AF warfighters the FY 2011 Base Plans:</li> <li>In FY 2011: Continue the development of the tools, technique required to build highly complex software-intensive systems. and simulations of select computationally challenging and relequantum information science testbed for optimized information design of petaflops embedded processing on-demand. Demo of fabricated prototype. Complete architectures for cognitive sprototype. Continue development of next generation advance superior information processing for AF warfighters through in-Initiate development of advanced processing capabilities to en information as close to the sensor as feasible.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	the development of high capacity amounts of raw data to actionable that enables complex software to be and identify functionality necessary for systems. Identify nodal design hierarchy ence testbed for optimized information as of select computationally challenging on advanced computing techniques, wrough in-house and university research.						
		0.000	1.873	3.293	0.000	3.293	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010					
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	<b>PROJECT</b> 625316: Inf	o Mgt and C	Computational Tech				
B. Accomplishments/Planned Program (\$ in Millions)	'		1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
MAJOR THRUST: Develop secure, manageable cross domain dis access to approved services outside of existing domain.	covery services that allow appropriate							
FY 2009 Accomplishments: In FY 2009: Not Applicable.								
FY 2010 Plans: In FY 2010: Initiate investigation of current lightweight director and design multi-level LDAP capability. Investigate current sta Identify best of breed capabilities and apply security to fulfill cr Develop flexible sensor interfaces to support rapid sensor repl modification of backend hardware or software infrastructure. E radios. Develop prioritized delivery mechanisms by integrating networking complementary capabilities.	ate of the art in web services discovery. oss-domain discovery requirements. acement and configuration without Evaluate impact of emerging tactical							
FY 2011 Base Plans: In FY 2011: Complete implementation of multi-level LDAP pro- compliant architecture, leveraging the existing multi-level repo- secure web services discovery prototype using multi-level LDA compliant architecture. Measure prototype scalability, perform management. Develop a flexible fusion container to allow ups core critical infrastructure. Demonstrate application to tracking development of advanced technologies to effectively manage the ISR enterprise.	sitory (MLR) technology. Implement AP authentication within a SOA hance, security, and ease of tream processing without affecting g of evasive non-linear targets. Initiate							
FY 2011 OCO Plans: In FY 2011 OCO: N/A								
MAJOR THRUST: Develop the architectural mechanisms that form high assurance systems.	n the basis for predictable software and	0.000	2.810	3.379	0.000	3.379		

APPROPRIATION/BUDGET ACTIVITY       R-1 ITEM NOMENCLATURE         3600: Research, Development, Test & Evaluation, Air Force       PE 0602788F: Dominant Information         BA 2: Applied Research       Technology         B. Accomplishments/Planned Program (\$ in Millions)       FY 2009 Accomplishments:         In FY 2009 Accomplishments:       In FY 2009: Not Applicable.         FY 2010 Plans:       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	FY 2009	PROJECT 625316: Inf FY 2010	fo Mgt and C FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments:         In FY 2009: Not Applicable.         FY 2010 Plans:         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.	FY 2009	FY 2010	-	-	-
<ul> <li>FY 2009 Accomplishments: In FY 2009: Not Applicable.</li> <li>FY 2010 Plans: 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.</li> </ul>	FY 2009	FY 2010	-	-	-
In FY 2009: Not Applicable. <i>FY 2010 Plans:</i> 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.					
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.					
mechanisms. FY 2011 Base Plans: In FY 2011: Complete prototype design and demonstrate functionality of a modular trusted computing base architecture. Develop trusted, automated cyber defense capability to reduce response time down to milli-seconds vice hours. Develop methods to use emerging commercial high assurance processors, virtualization, secure system development, self-protecting data for the hardening of commercial off-the-shelf products.					
FY 2011 OCO Plans: In FY 2011 OCO: N/A					
Accomplishments/Planned Programs Subtotals	0.000	33.674	30.804	0.000	30.804
C. Other Program Funding Summary (\$ in Millions)					
Line Item         FY 2009         FY 2010         FY 2011         FY 2011         FY 2011           • PE Not Provided (14555):         0.000	<u>FY 2013</u> 0.000	<u>FY 2014</u> 0.000		Cost To Complete 0.000	<u>Total Cos</u> 0.000
D. Acquisition Strategy Not applicable.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force	_	DATE: February 2010	
	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information</i> <i>Technology</i>	<b>PROJECT</b> 625316: <i>Inf</i>	o Mgt and Computational Tech

### 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, RDT&E Project Justification: PB 2011 Air Force							DATE: February 2010						
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Tes BA 2: Applied Research		n, Air Force					PE 0602788F: Dominant Information 625317: Information Decision Making Tech						ng Tech
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	16.869	18.835	0.000	18.835	17.962	18.696	20.325	20.394	Continuing	Continuing		

#### <u>Note</u>

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 that 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop next generation monitoring, planning, and assessment technologies enabling aerospace commanders to develop effects based campaigns.	0.000	3.698	5.683	0.000	5.683
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
FY 2010 Plans: 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					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	PROJECT 625317: Inf	r nformation Decision Making Tech				
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>information processing. Continue the application of system-o engineering in the creation of joint/integrated C2 capabilities. application of intelligent software agents as virtual battle staff processes. Initiate investigation of intelligent software agents (AOC)/platform operations. Continue the development of cap effects attainment at all levels of a campaign, linking leading i effects. Develop the capability to accomplish causal reasonin end-state, and capable of reasoning through uncertainty and the capability to analyze multiple courses of action (COA) hav time. Develop the capability to mix kinetic and non-kinetic op and indirect effects of each COA, and play COAs forward in ti decision points, and the foreclosure of options. Initiate invest support the rapid analysis of crisis-action plans or COA. Initi of next generation planning, decision making, and COA tools exercise a wide range of command and execution options for</li> <li><i>FY 2011 Base Plans:</i></li> <li>In FY 2011: Continue development of decision support science making concepts for C2 activities focused on integrated C2. C information systems capable of supporting joint/coalition C2 for changing environment. Continue to develop tools to increase of the air, space, and cyberspace domains through intelligent application of system-of-systems and federation-of-systems e integrated C2 capabilities emphasizing vertical and horizontal intelligent software agents for autonomous AOC/platform ope capability for a full-spectrum analysis for effects. Continue to develop to develop to develop to develop to develop to develop the application of system-of-systems and federation-of-systems e integrated C2 capabilities emphasizing vertical and horizontal intelligent software agents for autonomous AOC/platform ope capability for a full-spectrum analysis for effects. Continue to develop to develop.</li> </ul>	Complete the exploration of the members to enhance various C2 for autonomous air operations center vability for a full-spectrum analysis for ndicators to desired and undesirable ng, linking effects to actions to desired ambiguity. Continue research to achieve ving cascading effects in near real- tions, incrementally forecast the direct me to identify key plan dependencies, igation into wargaming technologies to ate in-house and university development supporting the commander's ability to AF forces.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	ז	PROJECT 625317: Int	<b>T</b> Information Decision Making Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>and ambiguity. Continue research to achieve the capability to analyze multiple COA having cascading effects in near real-time. Continue to develop and begin demonstrating capabilities to mix kinetic and non-kinetic options, continuously forecast the direct, indirect, and cascading effects of each COA, and play COAs forward in time to identify key plan dependencies, decision points, and the foreclosure of options. Continue investigating approaches to rapidly wargame crisis-action plans. Continue inhouse and university development of next generation planning, decision making, and COA tools supporting the commander's ability to exercise a wide range of command and execution options for AF forces. Develop techniques for courses-of-action analysis and assessments following cyber attacks on AF systems allowing commanders the ability to dynamically reallocate resources based on attack severity. Develop technologies to be able to reconsitute mission data and reestablish trust levels of DoD systems in a timely manner after a comprehensive cyber attack.</li> </ul>						
MAJOR THRUST: Investigate, analyze, and develop technologies for distributed intelligent information systems to varying crisis levels.	or automatic rapid reconfiguration of	0.000	10.368	8.877	0.000	8.877
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Continue to develop advanced interactive displays harsh environments with C2 applications and command centers techniques and AOC-based applications for information visualiz multiple, heterogeneous data sets. Continue to develop techno and interconnection of computer-based wargames used to prep strategies. Continue development of technologies for a holistic use to probe, study, analyze, visualize, reason, and predict activ	s. Continue development of advanced ation for use in conjunction with logies to improve the fidelity, accuracy, are contingency plans and response tool set that commanders can					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Informatio Technology	PROJECT 625317: Int	formation De	cision Makin	g Tech		
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>development of capabilities to be more agile within a net centre the ability for timely kinetic/non-kinetic option generation, sele that account for uncertainty and missing and erroneous inform making process between man and machine collaborating on or the development and demonstration of decision workflow and manage the C2 constellation of resources focused on specific</li> <li><i>FY 2011 Base Plans:</i></li> <li>In FY 2011: Complete development of advanced interactive of harsh environments with C2 applications and command center techniques and AOC-based applications for information visua multiple, heterogeneous data sets. Complete development of accuracy, and interconnection of computer-based wargames response strategies. Complete development of technologies can use to probe, study, analyze, visualize, reason, and predi development of capabilities to be more agile within a net centra ability for timely kinetic/non-kinetic option generation, selection account for uncertainty and missing and erroneous information processes between man and machine collaborating on compl development and demonstration of decision workflow and wormanage the command and control constellation of resources the capability to process and rapidly disseminate information to the capability to process and rapidly disseminate information to the capability to process and rapidly disseminate information to the capability to process and rapidly disseminate information to the capability to process and rapidly disseminate information to the capability to process and rapidly disseminate information to the capability to process and rapidly disseminate information to the capability to process and rapidly disseminate information to the capability to process and rapidly disseminate information to the capability to process and rapidly disseminate information to the capability to process and rapidly disseminate information to the capability to process and rapidly disseminate information to the capability to process and rapidly disseminate informatio</li></ul>	ction, and coordination capabilities nation, and supports intuitive decision complex, dynamic problems. Continue workload management capabilities to missions. lisplays suitable for rapid deployment in rs. Complete development of advanced lization for use in conjunction with technologies to improve the fidelity, used to prepare contingency plans and for a holistic tool set that commanders ct activities in the battlespace. Continue ric enabled environment. Develop the n, and coordination capabilities that n, and support intuitive decision making ex, dynamic problems. Continue the kload management capabilities to focused on specific missions. Develop						
FY 2011 OCO Plans: In FY 2011 OCO: N/A							
MAJOR THRUST: Investigate, analyze, and develop technologies seamless integrated C2 to achieve desired effects globally.	for planning, executing, and assessing	0.000	2.803	4.275	0.000	4.27	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	PROJECT 625317: Inf	<b>PROJECT</b> 25317: Information Decision Making					
B. Accomplishments/Planned Program (\$ in Millions)	·							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>FY 2009 Accomplishments: In FY 2009: Not Applicable.</li> <li>FY 2010 Plans: In FY 2010: Investigate processes and technologies and recom and Space Operations Center (AOC) to conduct kinetic/non-kin Execute (MAPE) while under degraded conditions due to cybe experimentation environment and conduct scenario-based inte evaluate measures of effectiveness (MOEs) and measures of p associated with integrated C2. Investigate methods to seamle non-geospatial data to enhance situational awareness and era space, and cyber domains. Develop applications for visualizin heterogeneous data in to a common operating picture of the ba an integrated task order synchronizing air, space, and cybersp effect.</li> <li>FY 2011 Base Plans: In FY 2011: Complete the investigation of processes and techn enable the AOC to conduct kinetic/non-kinetic MAPE procedur to cyber attacks. Complete development of an experimentation based integrated C2 studies. Complete development and evalu attributes associated with integrated C2. Complete investigation between geospatial and non-geospatial data to enhance situat decisions over the air, space, and cyberspace domains. Comp visualizing and exploring remotely accessed heterogeneous da the battlespace. Complete development of an integrated task or and cyberspace capabilities to achieve desired effect. Develop analyze C2 systems within a developmental environment. Develop</li> </ul>	netic Monitor, Assess, Plan, and r attacks. Design and develop an ograted C2 studies. Develop and performance (MOPs) for key attributes ssly move between geospatial and able integrated decisions over the air, g and exploring remotely accessed attlespace. Initiate an effort to develop ace capabilities to achieve desired nologies and recommend solutions to es while under degraded conditions due n environment and conduct scenario uation of MOEs and MOPs for key in of methods to seamlessly move ional awareness and enable integrated lete development of applications for ata into a common operational picture of order capability synchronizing air, space, n the capability to rapidly integrate and							

Exhibit R-2A, RDT&E Project Ju	ustification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information</i> <i>Technology</i>				<b>PROJECT</b> 625317: Information Decision Making Tech			
B. Accomplishments/Planned I	Program (\$ in N	lillions)	1								1
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
reconfigurable boundary cor missions.	nditions with the	goal of forci	ng an adver	sary to contir	nually re-plai	n their					
FY 2011 OCO Plans: In FY 2011 OCO: N/A											
			Accomplish	ments/Plann	ed Program	s Subtotals	0.000	16.869	18.835	0.000	18.83
C. Other Program Funding Sun	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u> <u>Base</u>	FY 2011 OCO	<u>FY 2011</u> <u>Total</u>	FY 2012	FY 2013	FY 2014	FY 2015	<u>Cost To</u> <u>Complete</u>	Total Cos
• PE Not Provided (14688): Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
<b>D. Acquisition Strategy</b> Not applicable.											
E. Performance Metrics Please refer to the Performance Force performance goals and m	•				Air Force re	esources are	e applied an	id how those	resources a	re contributi	ng to Air
		·									

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force       I							DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research			<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information</i> <i>Technology</i>				<b>PROJECT</b> 625318: Operational Awareness Tech				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
625318: Operational Awareness Tech	0.000	19.813	20.864	0.000	20.864	25.759	27.144	25.094	26.042	Continuing	Continuing

#### <u>Note</u>

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, situational awareness, understanding, and anticipation of the threats in the battlespace (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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop innovative multi-sensor collaborative fusion technologies in a fully distributed environment.	0.000	5.991	4.938	0.000	4.938
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
FY 2010 Plans: 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/					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: <i>Dominant Information</i> <i>Technology</i>	<b>PROJECT</b> 625318: <i>O</i>	perational Awareness Tech				
B. Accomplishments/Planned Program (\$ in Millions)	1		1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
advanced reasoning. Explore tracking techniques in combina improve the probability of correct association and extend track to investigate impacts of resource management. Examine and fusion utilizing resource allocation, mission planning, and cuei detected movement information and social network analysis to behavior of the enemy.	t lifetimes for moving targets. Continue d demonstrate distributed multi-platform ng. Develop the capability to utilize						
FY 2011 Base Plans: In FY 2011: Complete techniques and strategies for confusion Demonstrate the ability to track targets, exploiting feature data hour in moderate traffic density. Begin development and imple the scalability of tracking algorithms from 10's to 1000's of gro environment. Investigate ways of partitioning the area of inter sensing architecture vision. Initiate development of technique data for mining data across multi-INT repositories for behavior and track movement.	a, for an average of greater than 1 ementation of techniques to increase und targets in a large rural-urban est (AOI) based on the multi-layered s to improve analysis of multi-sensor						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop higher-level fusion and the enabling in to achieve situational awareness and understanding at all commar		0.000	1.510	3.614	0.000	3.614	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Complete development of automated reasoning t situations using adversarial capabilities. Initiate development							

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	<b>PROJECT</b> 625318: Operational Awareness Tech				
B. Accomplishments/Planned Program (\$ in Millions)	I		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
assessing activities to support situation assessment. Initiate in with level 1 - 4 fusion using multi-source intelligence and sense anticipate the variety of threats from the ground, air, and cyber	or feeds to advance the AF capability to					
FY 2011 Base Plans: In FY 2011: Continue development of techniques for analyzing situation assessment. Continue in-house and university resear multi-source intelligence and sensor feeds to advance the AF of threats from the ground, air, and cyber domains. Develop tech defensive capabilities including cyber intelligence collection and through future cyber attacks on AF systems. Develop capability and information to enhance cyber situational awareness. Develop agility by linking intelligence and cyber information operations.	rch dealing with level 1 - 4 fusion using capability to anticipate the variety of nologies for pre-positioning of cyber d analysis to enable AF's ability to fight by to incorporate mission context data					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop digital information exploitation technolo special signals intelligence, imagery, and measurement signatures.		0.000	3.625	6.599	0.000	6.599
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Continue the development and evaluation of wate include streaming data. Extend multimedia data technologies f on net-centric technology applications. Focus on information p processing technologies in the area of vocal tract modification. algorithms to enable improvements to intelligence, surveillance	for additional applications, with a focus rovenance. Analyze and develop audio Develop foundations, technology, and					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	1	<b>PROJECT</b> 625318: <i>O</i> µ	<b>T</b> Operational Awareness Tech			
B. Accomplishments/Planned Program (\$ in Millions)	,		1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
Further provide laboratory functionality to develop real time, ta for test and evaluation using operational data. Initiate the dev to identify and classify an application layer (request/reply) me that provides client/server communication between devices con networks, for supervisory control and data acquisition (SCAD/ specific characteristics. Extend and incorporate these character Initiate in-house and university research in advanced exploitate AF ability to gather, process, and display information from mu warfighters across the physical and cyber domains.	elopment and evaluation of algorithms ssaging protocol (termed MODBUS) onnected on different types of buses or A) systems, including field and protocol teristics into lab-generated test sets. tion techniques that maximize the						
FY 2011 Base Plans: In FY 2011: Continue the development and evaluation of wat beginning extensions to non-multimedia data and executable within network and ISR-centric scenarios. Continue work tow information, and investigate usage of intrinsic watermarks for methods for verification and absolute measures of effectivene evaluation of real time, tactical information exploitation softwa data. Develop a wide variety of exploitation methods to enhan Complete SCADA protocols, integrate all algorithms, demonst as an extensible proof-of-concept. Verify and validate algorith real-world data. Prepare for spiral development, including con recommendations. Continue in-house and university research that maximize the AF ability to gather, process, and display in identifying threats to warfighters across the physical and cybe optimizing exploitation across sensors to enhance multi-intellin exploitation methods to enhance signals situational awarenes	code. Continue to focus on application and the integration of provenance these purposes. Identify potential ss. Continue the development, test, and re using laboratory tools and operational nee signals situational awareness. trate and test a prototype analysis suite im performance against simulated mplete documentation of findings and n in advanced exploitation techniques formation from multi-INT sources r domains. Initiate the development of gence fusion. Develop a wide variety of						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology	n	<b>PROJECT</b> 625318: <i>Op</i>	vareness Teo	: Tech	
B. Accomplishments/Planned Program (\$ in Millions)	I		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 OCO Plans: In FY 2011 OCO: N/A						
MAJOR THRUST: Research and evaluate capabilities for reasoni and group discovery, and advanced analysis for situational awarer <i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.		0.000	2.041	1.834	0.000	1.834
FY 2010 Plans: In FY 2010: Develop and complete a framework for documen based on information extracted from the text and ontological w techniques for analysis of audio sources as well as alternate s analysis metrics to determine high value targets. Initiate rese simultaneous analysis of large volumes of streaming data with	vorld knowledge. Develop and complete sources by applying social network arch on dynamic networks over time for					
FY 2011 Base Plans: In FY 2011: Initiate development automated generation of on data sources, in particular the learning of linkages or relations necessary for advanced reasoning.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop modeling and simulation technologies assessment, and execution environments.	for the next generation of planning,	0.000	6.646	3.879	0.000	3.879
FY 2009 Accomplishments: In FY 2009: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602788F: Dominant Information Technology		<b>PROJECT</b> 625318: <i>O</i>	<b>T</b> Operational Awareness Tech		
B. Accomplishments/Planned Program (\$ in Millions)	·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans: In FY 2010: Complete research to forecast actionable futures to appraise and plan the "best" blue course of action for rapid development to model and explore policy actions and reaction activities. Initiate development of the nation state model (to in subsystems). Provide initial capability for the decision maker their interactions and interdependencies caused by "blue's" p and validation for integration of the various frameworks. Inveate capable of developing/managing sets of adversary futures forecast potential adversaries and events based on indication known and/or anticipated threat(s). Initiate development of an of adversary COAs based on the adversary's abilities and cap with various domains.</li> <li>FY 2011 Base Plans: In FY 2011: Complete development of the "core" nation state and social subsystems). Complete development to model an taken by the different modeled entities activities. Initiate development so by degree to which the adversary can achieve hypothesized eCC verification and validation for integration of the various frameworks based adversary adversary COAs based an achieve hypothesized eCC verification and validation for integration of the various framework and validation for integration of the various framework adversarial intentions in order to develop counter COA.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	decide, act, and adapt. Initiate ins taken by the different modeled entities include both the physical and social to understand varying degree of effects, otential actions. Initiate verification stigate development of techniques that s. Complete investigation of ability to s of known evidence and projected in integrated set of possible combinations babilities to perform activities associated e model (to include both the physical d explore policy actions and reactions elopment of tools for the analyst to identify actives. Initiate the identification of DAs based on predicted goals. Complete works. Continue development of an ased on the adversary's abilities and					

xhibit R-2A, RDT&E Project Ju	stification: PB	2011 Air Fo	rce						DATE: Febr	uary 2010		
<b>PPROPRIATION/BUDGET ACT</b> 600: Research, Development, Te A 2: Applied Research		, Air Force						<b>PROJECT</b> 625318: Operational Awareness Tech				
. Accomplishments/Planned P	rogram (\$ in M	lillions <u>)</u>				ſ						
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
			Accomplish	ments/Plann	ed Program	s Subtotals	0.000	19.813	20.864	0.000	20.86	
Conter Program Funding Sum     Line Item     PE Not Provided (14881):     Activity Not Provided     Acquisition Strategy     Not applicable     Performance Metrics     Please refer to the Performance     Force performance goals and m	<u>FY 2009</u> 0.000	FY 2010 0.000			FY 2011 Total 0.000	FY 2012 0.000	FY 2013 0.000	FY 2014 0.000	<u>FY 2015</u> 0.000	Cost To Complete 0.000	0.00	

Exhibit R-2, RDT&E Budget Item	Justification	: PB 2011 A	ir Force					DATE: February 2010			
					<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser Research</i>						
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	OCO         Total         FY 2012         FY 2013         FY 2014         FY 2015         Cost To					Total Cost		
Total Program Element	47.939	53.229	53.384	0.000	53.384	54.059	52.297	54.174	55.038	Continuing	Continuing
625096: High Energy Laser Research	47.939	53.229	53.384	0.000	53.384	54.059	52.297	54.174	55.038	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	49.268	52.754	0.000	0.000	0.000
Current President's Budget	47.939	53.229	53.384	0.000	53.384
Total Adjustments	-1.329	0.475	53.384	0.000	53.384
<ul> <li>Congressional General Reductions</li> </ul>		-6.100			
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000			
<ul> <li>Congressional Rescissions</li> </ul>	0.000	-0.225			
<ul> <li>Congressional Adds</li> </ul>		6.800			
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000			
<ul> <li>Reprogrammings</li> </ul>	0.000	0.000			
<ul> <li>SBIR/STTR Transfer</li> </ul>	0.000	0.000			
Other Adjustments	-1.329	0.000	53.384	0.000	53.384

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	D	TE: February 2010	)
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser Research</i>		
Congressional Add Details (\$ in Millions, and Includes Gener	ral Reductions)	FY 2009	FY 2010
Project: 625096: High Energy Laser Research			
Congressional Add: Advanced Deformable Mirrors for High E	Energy Laser Weapons.	0.000	1.593
Congressional Add: High Bandwidth, High Energy Storage, B	Exawatt Laser Glass Development.	0.000	2.788
Congressional Add: Planar Lightwave Circuit Development for	or High Power Military Laser Applications.	0.000	2.390
	Congressional Add Subtotals for Project: 625	0.000	6.771
	Congressional Add Totals for all Proje	octs 0.000	6.771

#### **Change Summary Explanation**

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

Note: In FY 2010, Congress added \$1.6 million for Advanced Deformable Mirrors for High Energy Laser Weapons, \$2.8 million for High Bandwidth, High Energy Storage, Exawatt Laser Glass Development, and \$2.4 million for Planar Lightwave Circuit Development for High Power Military Laser Applications.

C. Performance Metrics Under Development.

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Exhibit R-2A, RDT&E Project Jus	stification: Pl	3 2011 Air F	orce						DATE: February 2010			
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 2: Applied Research	earch, Development, Test & Evaluation, Air Force			<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser Research</i>				<b>PROJECT</b> 625096: High Energy Laser Research				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
625096: High Energy Laser Research	47.939	53.229	53.384	0.000	53.384	54.059	52.297	54.174	55.038	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. Accomplishments/Planned Program (\$ in Millions)

FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
8.000	12.605	13.764	0.000	13.76
			FY 2009 FY 2010 Base	FY 2009 FY 2010 Base OCO

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser R</i>	esearch	<b>PROJECT</b> 625096: <i>Hi</i> g	ROJECT 25096: High Energy Laser Rese		
B. Accomplishments/Planned Program (\$ in Millions)	1		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Conduct a joint-high power electric laser product government-sponsored measurements to validate performanc						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Mature solid state laser device technologies the performance.	at will provide improve system level	8.708	9.479	9.830	0.000	9.830
FY 2009 Accomplishments: In FY 2009: Developed power scaling architecture with good weight. Improved the efficiency and reliability of diode pump s combination concepts on testbed. Conducted Service and Ag	sources. Continued testing laser module					
FY 2010 Plans: In FY 2010: Combine high performance single modules in opti demonstrate the path to weapons-class scaling. Continue devision sources and fiber laser components. Investigate eye-safer last architectures. Conduct an industry proposal call for FY 2010.	velopment of high reliability diode pump					
FY 2011 Base Plans: In FY 2011: Demonstrate building block for highly efficient, co weapons-class applications. Demonstrate high reliability of di- laser technologies to higher powers. Conduct Service and Ag	ode pump sources. Scale eye-safer					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Investigate new technologies that have revolution	ionary potential for HEL applications.	4.520	4.601	7.790	0.000	7.790

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser R</i>	esearch	ch 625096: High Energy Lase			ch
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Developed materials with improved thermo-mecha pulse laser technologies in a laboratory environment. Demonst Investigated new laser materials for direct lasing in different wa Service and Agency proposal call for FY 2009, awarded new effective	rated novel beam control concepts. velength regimes. Conducted a					
FY 2010 Plans: In FY 2010: Incorporate new materials into a laser device and of wavelength selection, thermal handling, and overall laser effi technologies for military applications. Investigate advanced hyl beam phase control techniques. Conduct an industry proposal	ciency. Scale short pulse laser brid laser concepts and innovative					
FY 2011 Base Plans: In FY 2011: Explore novel laser technologies to improve efficie Demonstrate applications for short pulse laser technology. Sca moderate power levels. Conduct a Service and Agency propos	le electrically pumped alkali lasers to					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
<ul> <li>MAJOR THRUST: Conduct system level technology development a electron lasers (FELs) to weapons-class power levels and shipboard</li> <li><i>FY 2009 Accomplishments:</i></li> <li>In FY 2009: Completed prototype FEL demonstration activities scaling to a 100 kW lab demonstration with emphasis on technol (MW) future FEL performance. Conducted a Service and Agent three new efforts.</li> </ul>	d integration. . Investigated the development path for ologies that can support one megawatt	7.210	4.249	4.460	0.000	4.460

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser R</i>	esearch	PROJECT 625096: <i>Hig</i>	aser Researd	ch	
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Continue the development path for scaling to a 1 on technologies that can support one MW future FEL performs for FY 2010.	•					
FY 2011 Base Plans: In FY 2011: Demonstrate scaling to a 100 KW lab demonstra can support one MW future FEL performance. Conduct a Ser 2011.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Conduct technology experiments to select pror chemical laser technologies that can be scaled for strategic weapo	• • •	6.160	0.000	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Investigated alternate chemical processes and hi Developed concepts for gas lasing materials with high efficien of direct excitation gas lasers. Conducted a Service and Ager six new efforts.	cy. Investigated power scaling potential					
<i>FY 2010 Plans:</i> In FY 2010: Effort terminated.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser Re</i>	esearch	<b>PROJECT</b> 625096: <i>Hig</i>	gh Energy La	ser Researc	:h
B. Accomplishments/Planned Program (\$ in Millions)	1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop technology to support high performance demonstrations.	e beam control systems and integrated	9.490	9.626	9.980	0.000	9.980
FY 2009 Accomplishments: In FY 2009: Developed/provided beam control technology optic platforms (aircraft, ground vehicles and shipboard systems). In for negative effects of atmosphere and platform vibration. Conc call for FY 2009, awarded ten new efforts.	vestigated technologies to compensate					
FY 2010 Plans: In FY 2010: Demonstrate advanced component and control teo as high speed flight, high turbulence, and extended ranges. Co 2010.						
FY 2011 Base Plans: In FY 2011: Implement beam control technology options for las (aircraft, ground vehicles and shipboard systems) in stressing e Agency proposal call for FY 2011.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Conduct laser vulnerability experiments on mate a lethality database, and integrate into a systems-level architecture		3.851	4.053	4.640	0.000	4.640

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser R</i>	Research	<b>PROJECT</b> 625096: <i>Hi</i>	gh Energy La	aser Resear	ch
B. Accomplishments/Planned Program (\$ in Millions)			.1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Developed databases that will be accepted by the validated models for laser systems designers. Conducted lase components, and targets. Updated laser systems inputs for the	r vulnerability experiments on materials,					
FY 2010 Plans: In FY 2010: In close coordination with existing HEL models, in level HEL system models. Conduct laser vulnerability experim targets. Update laser systems inputs for the Joint Munitions Ef	ents on materials, components, and					
FY 2011 Base Plans: In FY 2011: In close coordination with existing HEL models, in level HEL system models. Conduct laser vulnerability experim targets. Update laser systems inputs for the Joint Munitions Ef	ents on materials, components, and					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Maintain and evaluate high-fidelity engineering Provide for HEL system modeling for into mission-level wargaming		0.000	1.845	2.920	0.000	2.920
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Complete, test, and demonstrate solid state laser scenario model and demonstrate engagement applications. De compensation components.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	<b>R-1 ITEM NOMENCLATURE</b> PE 0602890F: <i>High Energy Laser Re</i>	esearch	<b>PROJECT</b> 625096: <i>Hi</i>	gh Energy La	ch	
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Provide maintenance, verification, validation, and HEL models. Conduct mission-level HEL engagement scenari						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
Accor	mplishments/Planned Programs Subtotals	47.939	46.458	53.384	0.000	53.384
					I	
		FY 2009	FY 2010			
Congressional Add: Advanced Deformable Mirrors for High Energy	y Laser Weapons.	0.000	1.593			
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally-directed effort for Advar Energy Laser Weapons.	nced Deformable Mirrors for High					
Congressional Add: High Bandwidth, High Energy Storage, Exawa	att Laser Glass Development	0.000	2.788	-		
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for High I Exawatt Laser Glass Development.	Bandwidth, High Energy Storage,					

	ification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIV</b> 3600: Research, Development, Test BA 2: Applied Research		, Air Force		<b>R-1 ITEM NO</b> PE 0602890			esearch	PROJECT 625096: Hig	ligh Energy Laser Research		
B. Accomplishments/Planned Pro	gram (\$ in M	illions)	I					1			
							FY 2009	FY 2010			
							0.000				
Congressional Add: Planar Lightwa	ve Circuit De	velopment f	or High Pow	er Military La	ser Applicat	tions.					
FY 2009 Accomplishments: In FY 2009: Not Applicable.											
FY 2010 Plans: In FY 2010: Conduct Congress High Power Military Laser Appli		ed effort for	Planar Light	wave Circuit	Developme	nt for					
				Congre	ssional Add	s Subtotals	0.000	6.771			
C. Other Program Funding Summa	ary (\$ in Mill	ions)	FY 2011	FY 2011	FY 2011					Cost To	
			112011	112011	112011						
Line Item	FY 2009	FY 2010	Base			FY 2012	FY 2013	FY 2014	FY 2015		
• PE 0601108F: <i>High Energy</i>	<u>FY 2009</u> 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	<b>0CO</b> 0.000	<u>Total</u> 0.000	<u>FY 2012</u> 0.000	<u>FY 2013</u> 0.000	<u>FY 2014</u> 0.000	<u>FY 2015</u> 0.000	<u>Complete</u> 0.000	Total Cos
				000	Total					Complete	Total Cos
<ul> <li>PE 0601108F: High Energy Laser Research Initiatives.</li> <li>PE 0603444F: Maui Space</li> </ul>				000	Total					Complete	<u>Total Cos</u> 0.000
<ul> <li>PE 0601108F: High Energy Laser Research Initiatives.</li> <li>PE 0603444F: Maui Space Surveillance System.</li> </ul>	0.000	0.000	0.000	0.000	<u>Total</u> 0.000 0.000	0.000	0.000	0.000	0.000	Complete 0.000 0.000	<u>Total Cos</u> 0.000 0.000
<ul> <li>PE 0601108F: High Energy Laser Research Initiatives.</li> <li>PE 0603444F: Maui Space Surveillance System.</li> <li>PE 0603605F: Advanced</li> </ul>	0.000	0.000	0.000	<u>0C0</u> 0.000	<u>Total</u> 0.000	0.000	0.000	0.000	0.000	<u>Complete</u> 0.000	<u>Total Cos</u> 0.000 0.000
<ul> <li>PE 0601108F: High Energy Laser Research Initiatives.</li> <li>PE 0603444F: Maui Space Surveillance System.</li> <li>PE 0603605F: Advanced Weapons Technology.</li> </ul>	0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	Total 0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	Complete 0.000 0.000 0.000	Total Cost 0.000 0.000 0.000
<ul> <li>PE 0601108F: High Energy Laser Research Initiatives.</li> <li>PE 0603444F: Maui Space Surveillance System.</li> <li>PE 0603605F: Advanced Weapons Technology.</li> <li>PE 0603924F: High Energy</li> </ul>	0.000	0.000	0.000	0.000	<u>Total</u> 0.000 0.000	0.000	0.000	0.000	0.000	Complete 0.000 0.000	Total Cos 0.000 0.000 0.000
<ul> <li>PE 0601108F: High Energy Laser Research Initiatives.</li> <li>PE 0603444F: Maui Space Surveillance System.</li> <li>PE 0603605F: Advanced Weapons Technology.</li> </ul>	0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	Total 0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	Complete 0.000 0.000 0.000	Total Cos 0.000 0.000 0.000
<ul> <li>PE 0601108F: High Energy Laser Research Initiatives.</li> <li>PE 0603444F: Maui Space Surveillance System.</li> <li>PE 0603605F: Advanced Weapons Technology.</li> <li>PE 0603924F: High Energy Laser Advanced Technology</li> </ul>	0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	<u>Total</u> 0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	0.000 0.000 0.000	Complete 0.000 0.000 0.000	Total Cos 0.000 0.000 0.000 0.000
<ul> <li>PE 0601108F: High Energy Laser Research Initiatives.</li> <li>PE 0603444F: Maui Space Surveillance System.</li> <li>PE 0603605F: Advanced Weapons Technology.</li> <li>PE 0603924F: High Energy Laser Advanced Technology Program.</li> <li>PE 0603883C: Ballistic Missile Defense Boost Phase Segment.</li> </ul>	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000	Total           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000	Complete 0.000 0.000 0.000 0.000 0.000	Total Cos 0.000 0.000 0.000 0.000
<ul> <li>PE 0601108F: High Energy Laser Research Initiatives.</li> <li>PE 0603444F: Maui Space Surveillance System.</li> <li>PE 0603605F: Advanced Weapons Technology.</li> <li>PE 0603924F: High Energy Laser Advanced Technology Program.</li> <li>PE 0603883C: Ballistic Missile Defense Boost Phase Segment.</li> <li>PE 0602605F: Directed Energy</li> </ul>	0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000	Total           0.000           0.000           0.000           0.000           0.000           0.000	0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000	Complete 0.000 0.000 0.000 0.000	Total Cos 0.000 0.000 0.000 0.000
<ul> <li>PE 0601108F: High Energy Laser Research Initiatives.</li> <li>PE 0603444F: Maui Space Surveillance System.</li> <li>PE 0603605F: Advanced Weapons Technology.</li> <li>PE 0603924F: High Energy Laser Advanced Technology Program.</li> <li>PE 0603883C: Ballistic Missile Defense Boost Phase Segment.</li> </ul>	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000	Total           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000	Complete 0.000 0.000 0.000 0.000 0.000	Total Cos 0.000 0.000 0.000

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVI</b> 3600: Research, Development, Test BA 2: Applied Research		, Air Force		<b>R-1 ITEM NO</b> PE 0602890	-	-	esearch	<b>PROJECT</b> 625096: <i>Hig</i>	igh Energy Laser Research			
C. Other Program Funding Summa	ary (\$ in Mill	ions)		1				1				
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>		
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	Base	000	<u>Total</u>	<u>FY 2012</u>	FY 2013	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost	
• PE 0602114N: Power Projection	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Applied Research.												
• PE 0602120A: Sensors and Electronic Survivability.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0603004A: Weapons and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Munitions Advanced Technology.												
• PE 0602702E: Tactical	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Technology.	0.000	0.000	0 000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0 000	
• PE 0603175C: Ballistic Missile Defense Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0602651M: Joint Non-Lethal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Weapons Applied Research.												
• PE 0603651M: Joint Non-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Lethal Weapons Technology Development.												
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, RDT&E Budget Item J	lustification	: PB 2011 A	ir Force						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develo	& Evaluatio	,		<b>R-1 ITEM N</b> PE 0603112		TURE ed Materials :	for Weapon	Systems			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	62.070	67.856	33.414	0.000	33.414	40.341	42.098	44.191	43.239	Continuing	Continuing
632100: Laser Hardened Materials	22.377	24.177	19.853	0.000	19.853	23.399	22.714	24.228	25.617	Continuing	Continuing
633153: Non-Destructive Inspection Development	8.081	4.038	2.260	0.000	2.260	5.379	7.509	7.580	5.444	Continuing	Continuing
633946: Materials Transition	16.412	28.502	9.039	0.000	9.039	9.167	8.945	9.331	9.612	Continuing	Continuing
634918: Deployed Air Base Demonstrations	11.232	11.139	2.262	0.000	2.262	2.396	2.930	3.052	2.566	Continuing	Continuing
6377SP: Advanced Space Materials	3.968	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### <u>Note</u>

Note: In FY 2010, funds from Project 77SP have been moved to Project 2100 within this Program Element to more accurately align efforts. In FY 2011, funds moved from Project 2100 to Project 4348 to increase emphasis in applied research.

#### 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, RDT&E Budget Item Justification: PB 2011 Air Fo	orce			DATE:	February 2010	)
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)		EM NOMENCLA 03112F: Advanc	<b>NTURE</b> ed Materials for Weapor	n Systems		
B. Program Change Summary (\$ in Millions)						
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011	
Previous President's Budget	62.676 62.070	37.901 67.856	0.000 33.414	0.000 0.000		0.000 3.414
Current President's Budget Total Adjustments	-0.606	29.955	33.414	0.000	-	3.414 3.414
Congressional General Reductions	-0.000	0.000	55.414	0.000	5	5.414
Congressional Directed Reductions		0.000				
Congressional Rescissions	0.000	-0.285				
Congressional Adds		30.240				
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000				
Reprogrammings	0.000	0.000				
SBIR/STTR Transfer	0.000	0.000	00.444			~
Other Adjustments	-0.606	0.000	33.414	0.000	3	3.414
Congressional Add Details (\$ in Millions, and Includes	s General Red	<u>uctions)</u>			FY 2009	FY 2010
Project: 633153: Non-Destructive Inspection Developme	ent					
Congressional Add: Materials Integrity Management	Research for A	ir Force Systems	2		0.798	0.000
Congressional Add: Sonic Infrared Imaging Technology	gy Developmei	nt.			0.798	0.000
Congressional Add: Aircraft Evaluation Readiness Ini	itiative (AERI).				2.394	2.390
		Cong	ressional Add Subtotals	s for Project: 633153	3.990	2.390
Project: 633946: Materials Transition				-		
Congressional Add: Metals Affordability Initiative.					3.989	9.958
Congressional Add: EMI Grid Fabrication Technology	Ι.				2.713	2.390
Congressional Add: Silicon Carbide Electronics Mate	rial Producibilit	y Initiative.			4.787	5.019
Congressional Add: SiC-RF Power for Avionics Syste	ems.			-	0.000	1.593
		Cong	pressional Add Subtotals	s for Project: 633946	11.489	18.960

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	D	ATE: February 2010	0
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: Advanced Materials for Weapon Systems		
Congressional Add Details (\$ in Millions, and Includes Ger	eral Reductions)	FY 2009	FY 2010
Project: 634918: Deployed Air Base Demonstrations			
Congressional Add: Body Armor Improved Ballistic Protect	tion.	1.995	1.753
Congressional Add: Strategic Biofuels Supply System.		0.997	1.593
Congressional Add: Sewage-Derived Biofuels Program.		2.393	3.824
Congressional Add: Military Waste-to-Energy Project Using	g the Hydro-Thermal Energy Conversion (Hy-TEC) Process.	0.000	1.593
	Congressional Add Subtotals for Project: 634	918 5.385	8.763
	Congressional Add Totals for all Proj	ects 20.864	30.113

#### **Change Summary Explanation**

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

In FY 2010, Congress added \$2.4 million for Aircraft Evaluation Readiness Initiative, \$1.76 million for Body Armor Improved Ballistic Protection, Research and Development, \$2.4 million for EMI Grid Fabrication Technology, \$10.0 million for Metals Affordability Initiative, \$1.6 million for Military Waste-to-Energy Project Using the Hydro-Thermal Energy Conversion (Hy-TEC) Process, \$3.84 million for Sewage-Derived Biofuels Program, \$1.6 million for Silc-RF Power for Avionics Systems, \$5.04 million for Silicon Carbide Electronics Material Producibility Initiative, and \$1.6 million for Strategic Biofuels Supply System.

C. Performance Metrics Under Development.

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Exhibit R-2A, RDT&E Project Just	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force										DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)					IOMENCLA 2F: Advance		for Weapon	<b>PROJECT</b> 632100: <i>La</i>	OJECT 2100: Laser Hardened Materials				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011FY 2011OCOTotalFY 2012EstimateEstimateEstimateEstimate				FY 2014 Estimate	FY 2015 Estimate	Cost To Total Complete Cost			
632100: Laser Hardened Materials	22.377	24.177	19.853							Continuing	Continuing		

#### <u>Note</u>

Note: Funds from Project 77SP have been moved to Project 2100 within this Program Element to more accurately align efforts. Note: Beginning in FY 2011, funds from Project 2100 have been moved to Program Element 0602102F BPAC 4348 to increase emphasis on applied research.

#### 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Major Thrust: Develop and demonstrate materials technologies that enhance hardening for sensors, avionics, and components to increase survivability and mission effectiveness of aerospace systems.	16.568	20.010	16.792	0.000	16.792
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Transitioned mature hardening materials technology for an Air Force tactical system. Demonstrated performance of dual band limiter materials in tactical systems.</li> <li>FY 2010 Plans:</li> <li>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 and electro-optical sensors and space structural materials.</li> </ul>					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: Advanced Materials for Systems	Weapon	<b>PROJECT</b> 632100: <i>La</i>	ser Hardene	d Materials			
B. Accomplishments/Planned Program (\$ in Millions)	· · ·							
	F	TY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Evaluate hardening performance of current material Demonstrate detector hardening for next generation USAF targe persistent surveillance detectors with increased survivability. De Incorporate materials in optical test bed configuration and test per Demonstrate optimized nonlinear optical limiter materials for dan semiconductor optical limiter materials performance for damage hardening SWIR sensor systems. Evaluate materials survivabilit advanced thin film concepts for enhanced fixed filter performance</li> <li>FY 2011 OCO Plans: In FY2011 OCO: N/A.</li> </ul>	ting platforms. Develop new sign more robust Vis/NIR detectors. erformance in relevant environments. nage protection. Demonstrate protection. Verify performance of ty for relevant environments. Develop							
Major Thrust: Develop and demonstrate materials technologies that e aircrews to ensure safety and to enable aircrew to perform required n		5.809	4.167	3.061	0.000	3.061		
FY 2009 Accomplishments: In FY 2009: Transitioned advanced agile filters and optical power configuration. Demonstrated agile filter and optical limiter device								
<i>FY 2010 Plans:</i> In FY 2010: Integrate fixed optical coatings within visor applicati	ons for demonstration.							
FY 2011 Base Plans: In FY 2011: Investigate susceptibility of candidate detectors for enhanced photorefractive hybrid materials concepts for Air Force Identify personnel protection technologies for the visible and SW coatings within visor applications.	e passive protection applications.							

Exhibit R-2A, RDT&E Project Jus	tification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Tes BA 3: Advanced Technology Develo	t & Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603112 <i>Systems</i>			or Weapon	<b>PROJECT</b> 632100: <i>La</i>	ser Hardene		
<b>B. Accomplishments/Planned Pro</b>	ogram (\$ in M	lillions <u>)</u>									
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY2011 OCO: N/A.											
			Accomplish	ments/Plann	ed Program	s Subtotals	22.377	24.177	19.853	0.000	19.853
C. Other Program Funding Summ	nary (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	FY 2009	<u>FY 2010</u>	<b>Base</b>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<b>Complete</b>	Total Cost
• PE 0602102F: <i>Materials.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602202F: <i>Human</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Effectiveness Applied Research.											
• PE 0603231F: Crew Systems and Personnel Protection Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0604706F: <i>Life Support Systems.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

#### **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-2A, RDT&E Project Ju	stification: PE	3 2011 Air F	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force							DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE         PROJECT           PE 0603112F: Advanced Materials for Weapon         633153: Non-Destructive Inspect           Systems         Development					on-Destructive Inspection			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost		
633153: Non-Destructive Inspection Development	8.081	4.038	2.260	0.000	2.260	5.379	7.509	7.580	5.444	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
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.	0.527	0.200	0.650	0.000	0.650
FY 2009 Accomplishments: In FY 2009: Demonstrated NDI/E approaches to extend the life of fracture-critical gas turbine engine components.					
FY 2010 Plans: In FY 2010: Validate NDI/E approaches to extend the life of fracture-critical gas turbine engine components.					
FY 2011 Base Plans: In FY 2011: Transition NDI/E approaches to extend the life of fracture-critical gas turbine engine components.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: Advanced Materials Systems	on-Destructive Inspection ent				
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate advanced inspection (LO) systems to enhance affordability and ensure full performance		0.339	0.779	0.351	0.000	0.351
FY 2009 Accomplishments: In FY 2009: Developed and demonstrated a multiuse, multipl user requirements.	atform LO NDI/E hand tool that meets					
FY 2010 Plans: In FY 2010: Transition a common, multiuse, multiplatform, ha sensor system.	ndheld LO NDI/E point inspection tool/					
FY 2011 Base Plans: In FY 2011: Develop inspection methods and sensor technolo next generation LO material systems.	ogy for signature and material integrity of					
FY 2011 OCO Plans: In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate technologies for important monitoring, and testing of aircraft to reduce operations, maintenant		1.645	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Transitioned application-focused NDI/E technolo requirements for aging aircraft.	gies to meet emerging inspection					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: Advanced Materials Systems	PE 0603112F: Advanced Materials for Weapon 633153: N				
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
FY 2011 OCO Plans: In FY11 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate advanced systems st on-board and embedded sensing to gain continuous awareness of		1.580	0.669	1.259	0.000	1.259
FY 2009 Accomplishments: In FY 2009: Developed optimal sensing approaches for real-tin temperature protection systems and characterize power scave Transitioned smart sensor technologies for wiring health analysi inspection tool for assessing the structural health of airframes.	nging and signal transmission issues.					
FY 2010 Plans: In FY 2010: Develop and demonstrate optimal sensing approa high-temperature protection and advanced material systems ar signal transmission issues. Validate smart sensor technologies field- and depot-level inspection tools for assessing the structu	nd characterize power scavenging and s for wiring health analysis. Validate					
FY 2011 Base Plans: In FY 2011: Demonstrate optimal sensing approaches for real- temperature protection and advanced material systems and ch transmission issues. Transition smart sensor technologies for and depot-level inspection tools for assessing the structural he	aracterize power scavenging and signal wiring health analysis. Transition field-					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: Advanced Materials for Systems	rials for Weapon 633153: Non-Destructive Inspection Development						
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
Acco	mplishments/Planned Programs Subtotals	4.091	1.648	2.260	0.000	2.26		
	]	FY 2009	FY 2010	]				
Congressional Add: Materials Integrity Management Research for	Air Force Systems.	0.798	0.000					
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Ma for Air Force Systems.	aterials Integrity Management Research							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.								
Congressional Add: Sonic Infrared Imaging Technology Developn	nent	0.798	0.000					
<i>FY 2009 Accomplishments:</i> In FY 2009: Conducted Congressionally-directed effort for Sc Development.								
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.								
Congressional Add: Aircraft Evaluation Readiness Initiative (AERI	).	2.394	2.390					
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for AE								

Exhibit R-2A, RDT&E Project J	ustification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET AC 3600: Research, Development, T BA 3: Advanced Technology Dev	Test & Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603112 <i>Systems</i>			or Weapon	PROJECT 633153: No Developme	3: Non-Destructive Inspection			
B. Accomplishments/Planned	Program (\$ in M	illions <u>)</u>										
		-					FY 2009	FY 2010	]			
<i>FY 2010 Plans:</i> In FY 2010: Conduct Cong	ressionally-direct	ed effort for	AERI.									
				Congre	ssional Add	s Subtotals	3.990	2.390				
C. Other Program Funding Sur	nmary (\$ in Mill	ions)										
Line Item • PE 0602102F: Materials.	<u>FY 2009</u> 0.000	<u>FY 2010</u> 0.000	FY 2011 Base 0.000	FY 2011 OCO 0.000	<u>FY 2011</u> <u>Total</u> 0.000	<u>FY 2012</u> 0.000	<u>FY 2013</u> 0.000	<u>FY 2014</u> 0.000	<u>FY 2015</u> 0.000	Cost To Complete 0.000	<u>Total Cost</u> 0.000	
D. Acquisition Strategy Not Applicable.												
E. Performance Metrics	e Base Budget (	wenview Boo	ok for inform	ation on how			annlied an	d how those	resources a	re contributi	na to Air	

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, RDT&E Project Justification: PB 2011 Air Force       DATE: F								DATE: Feb	ruary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATUREPPE 0603112F: Advanced Materials for Weapon63Systems63					<b>PROJECT</b> 633946: <i>Materials Transition</i>		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
633946: Materials Transition	16.412	28.502	9.039	0.000	9.039	9.167	8.945	9.331	9.612	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop & demonstrate M&P technologies for air vehicle & subsystems to enhance lift, propulsion, low-observable performance, power generation management, & affordability of air vehicles.	3.692	3.140	4.254	0.000	4.254
FY 2009 Accomplishments: In FY 2009: Validated materials-damage predictive approaches for engine health determination and life extension capability. Transitioned 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. Evaluated domestic lithium ion precursor materials, active materials, associated testing, and battery-cell manufacturing for acceleration of industrial development.					
FY 2010 Plans: 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.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE		PROJECT	DATE: Febr					
3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	PE 0603112F: Advanced Materials f Systems	or Weapon		: Materials Transition					
B. Accomplishments/Planned Program (\$ in Millions)									
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total			
FY 2011 Base Plans: In FY 2011: Develop and transition production-level capable p quality diamond windows for airborne high power microwave of and compare advantages of approaches for high energy dens applications. Initiate validation of processing methods and lifting validation of processing methods and lifting methodologies for and demonstrate methodology for process control and validation systems.	lirected energy weapons. Demonstrate ity capacitors for pulsed power ng tools for hybrid disk concepts. Initiate advanced SiC/SiC composites. Develop								
FY 2011 OCO Plans: In FY2011 OCO: N/A.									
MAJOR THRUST: Develop & demonstrate M&P technologies to er systems by lowering O&M costs to ensure the full operability and s		1.231	4.402	0.711	0.000	0.71			
FY 2009 Accomplishments: In FY 2009: Developed test methodologies and evaluation teo emerging materials and processes for sustainment of Air Forc									
FY 2010 Plans: In FY 2010: Demonstrate innovative technologies for bare bas manufacturing processes to achieve dramatic reductions in no tooling costs and schedules for composite and metallic aircraf stir welding.	nrecurring fabrication and assembly								
FY 2011 Base Plans: In FY 2011: Demonstrate and transition innovative technolog	ies for bare base utilities.								

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: Advanced Materials for Systems	PE 0603112F: Advanced Materials for Weapon 633946:				
B. Accomplishments/Planned Program (\$ in Millions)	I		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY2011 OCO: N/A.						
MAJOR THRUST: Develop & demonstrate affordable, novel high to thermal management concepts to enable future defense capabilities		0.000	2.000	4.074	0.000	4.074
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Identify key issues and structural concepts for hor systems to be fabricated from advanced ceramics, ceramic ma metals and intermetallics.						
FY 2011 Base Plans: In FY 2011: Explore fabrication techniques for hot structure an advanced ceramics, CMCs, hybrids and advanced metals and						
FY 2011 OCO Plans: In FY2011 OCO: N/A.						
Ассо	mplishments/Planned Programs Subtotals	4.923	9.542	9.039	0.000	9.039
		FY 2009	FY 2010	]		
		3.989	9.958	-		
Congressional Add: Metals Affordability Initiative.		0.009	0.000			
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Me	etals Affordability Initiative.					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DA	TE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: Advanced Materials for Weapon Systems	PROJECT 633946: Mater	ials Transition
B. Accomplishments/Planned Program (\$ in Millions)		1	
	FY 2009	FY 2010	
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally-directed effort for Metals	s Affordability Initiative.		
Congressional Add: EMI Grid Fabrication Technology.	2.713	2.390	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for EM	I Grid Fabrication Technology.		
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for EMI G	Grid Fabrication Technology.		
Congressional Add: Silicon Carbide Electronics Material Producibil	4.787 tity Initiative.	5.019	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Silio Producibility Initiative.	con Carbide Electronics Material		
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Silicor Producibility Initiative.	n Carbide Electronics Material		
Congressional Add: SiC-RF Power for Avionics Systems.	0.000	1.593	
FY 2009 Accomplishments: In FY 2009: Not Applicable.			
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for SiC-R	F Power for Avionics Systems.		

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Exhibit R-2A, RDT&E Project Just	tification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
3600: Research, Development, Tes	<b>PROPRIATION/BUDGET ACTIVITY</b> 00: Research, Development, Test & Evaluation, Air Force 3: Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATUREPROJECTPE 0603112F: Advanced Materials for Weapon633946: MSystemsSystems					
<b>B. Accomplishments/Planned Pro</b>	ogram (\$ in M	illions <u>)</u>									
							FY 2009	FY 2010			
				Congre	ssional Add	s Subtotals	11.489	18.960			
C. Other Program Funding Summ	ary (\$ in Milli	<u>ons)</u>	<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	FY 2009	<u>FY 2010</u>	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost
• PE 0602102F: <i>Materials.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603203F: Advanced Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603211F: Aerospace Technology Dev/Demo.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603216F: Aerospace Propulsion and Power Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

#### **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, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: Advanced Materials for Weapon Systems				<b>PROJECT</b> 634918: <i>Deployed Air Base Demonstrations</i>				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
634918: Deployed Air Base Demonstrations	11.232	11.139	2.262	0.000	2.262	2.396	2.930	3.052	2.566	Continuing	Continuing	

#### 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Demonstrate & transition deployable infrastructure airbase technologies, to reduce airlift & manpower requirements, setup time, & sustainment costs in support of AEF operations.	4.338	1.157	1.074	0.000	1.074
FY 2009 Accomplishments: In FY 2009: Developed best methods for integration of advanced power generation and distribution. Characterized and made ensure processes for innovative technologies. Began 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.					
FY 2010 Plans: 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 sustain aircraft operations. Demonstrate and analyze rapid temporary and permanent high temperature operating surface repairs.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010					
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	opment, Test & Evaluation, Air Force PE 0603112F: Advanced Materials			PROJECT 634918: Deployed Air Base Demo			
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 Base Plans: In FY 2011: Demonstrate and transition integrated, advanced methods. Demonstrate methods and technologies to evaluate sustain remote and autonomous aircraft operations. Demonst permanent high temperature operating surface repairs.	operating surfaces for ability to						
FY 2011 OCO Plans: In FY2011 OCO: N/A.							
MAJOR THRUST: Demonstrate and transition technologies to pro capability for deployed AEF operations.	vide force protection and fire fighting	1.509	1.219	1.188	0.000	1.18	
FY 2009 Accomplishments: In FY 2009: Validated and fabricated improved blast suppress protection materials for new and existing structures. Demonst technologies. Evaluated and characterize improved fire fighter technology to operational units. Characterized and analyzed/e nozzles, and other innovative technologies with test bed vehic model/evaluate reactive filtration effectiveness for expeditional	rated and validated explosives detection safety technologies and transition evaluated ultrahigh pressure, standoff es. Characterized air filtration and						
FY 2010 Plans: In FY 2010: Demonstrate agile and lightweight adaptive blast structures. Integrate and demonstrate candidate fire fighter sa environments and threats. Integrate and demonstrate candida other technologies in fire safety systems. Demonstrate air filtra for expeditionary structures and personnel protection.	fety technologies against representative te ultrahigh pressure, nozzles, and						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: Advanced Materials for Systems	or Weapon	<b>PROJECT</b> 634918: <i>De</i>	strations		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Demonstrate and transition agile, lightweight ada in representative structures. Demonstrate and optimize candid against representative environments and threats. Demonstrate pressure, nozzles, and other technologies in fire safety system and responsive materials for platforms, expeditionary structure	date fire fighter safety technologies e and transition candidate ultrahigh is. Develop and demonstrate reactive					
<i>FY 2011 OCO Plans:</i> IN FY 2011 OCO: N/A.						
Acco	mplishments/Planned Programs Subtotals	5.847	2.376	2.262	0.000	2.262
	٦	FY 2009	FY 2010			
		1.995	1.753			
Congressional Add: Body Armor Improved Ballistic Protection.		1.995	1.755			
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Bo	dy Armor Improved Ballistic Protection.					
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Body	Armor Improved Ballistic Protection.					
		0.997	1.593			
Congressional Add: Strategic Biofuels Supply System.						

Exhibit R-2A, RDT&E Project Just	i <b>fication:</b> PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develop	& Evaluation	, Air Force		<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: Advanced Materials f Systems				<b>PROJECT</b> 634918: <i>De</i>	eployed Air E	Base Demons	trations
B. Accomplishments/Planned Pro	gram (\$ in N	lillions)									
-						[	FY 2009	FY 2010	]		
FY 2010 Plans: In FY 2010: Conduct Congress	ionally-direc	ted effort for	Strategic Bi	ofuels Supply	y System.						
Congressional Add: Sewage-Derive	ed Biofuels P	rogram.					2.393	3.824			
FY 2009 Accomplishments: In FY 2009: Conducted Congre	essionally-dir	ected effort f	for Sewage-I	Derived Biofu	uels Prograr	n.					
FY 2010 Plans: In FY 2010: Conduct Congress	ionally-direc	ted effort for	Sewage-De	rived Biofuel	s Program.						
Congressional Add: Military Waste- TEC) Process.	to-Energy Pr	oject Using	the Hydro-Th	nermal Energ	gy Conversio	on (Hy-	0.000	1.593			
FY 2009 Accomplishments: In FY 2009: Not Applicable.											
FY 2010 Plans: In FY 2010: Conduct Congress Hydro-Thermal Energy Convers			Military Was	ste-to-Energy	/ Project Usi	ng the					
				Congre	ssional Add	s Subtotals	5.385	8.763	-		
C. Other Program Funding Summa	arv (\$ in Mill	ions)							-		
	- <b>,</b> , ·	<i>+</i>	<u>FY 2011</u>	FY 2011	<u>FY 2011</u>					Cost To	
	<u>FY 2009</u> 0.000	<u>FY 2010</u>	Base	000	<u>Total</u>	FY 2012	FY 2013			<u>Complete</u>	Total Cos 0.00
• PE 0602102F: Materials.		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

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Exhibit R-2A, RDT&E Project Jus	tification: PB	2011 Air Fo	rce					DATE: February 2010				
APPROPRIATION/BUDGET ACTI 3600: Research, Development, Tes BA 3: Advanced Technology Develo	t & Evaluation			R-1 ITEM NO PE 0603112 Systems			or Weapon	<b>PROJECT</b> 634918: <i>De</i>	<b>DJECT</b> 918: Deployed Air Base Demonstrati			
C. Other Program Funding Sumn	nary (\$ in Mill	ions)										
Line Item • PE 0604617F: Agile Combat Support.	<u>FY 2009</u> 0.000	<b>FY 2010</b> 0.000	FY 2011 Base 0.000	FY 2011 OCO 0.000	<u>FY 2011</u> <u>Total</u> 0.000	<u>FY 2012</u> 0.000	<b>FY 2013</b> 0.000	<u>FY 2014</u> 0.000	FY 2015 0.000	Cost To Complete 0.000	<u>Total Cost</u> 0.000	

#### **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, RDT&E Project Jus	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									ruary 2010		
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 3: Advanced Technology Devel	st & Evaluatio	Evaluation, Air Force PE 0603112F: Advanced Materials for Weapon 6377SP: Advanced Space Materials				ace Materials	3					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
6377SP: Advanced Space Materials	3.968	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing	

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop & demonstrate advanced M&P technologies to enable revolutionary improvements in the performance of air-breathing and rocket-based aerospace vehicles and weapons.	1.853	0.000	0.000	0.000	0.000
<i>FY 2009 Accomplishments:</i> In FY 2009: Utilized newly developed materials approaches, fabricate thermal protection system sub-components for high temperature testing. Developed a sub-component cryogenic tank article and demonstrate the integration of ceramic, metallic, and carbon-carbon thermal protection system components.					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603112F: Advanced Materials f Systems	or Weapon	PROJECT 6377SP: Ac	lvanced Spa	ce Materials	
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate advanced material space systems.	s technologies that enhance hardening for	2.115	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Fabricated and demonstrated limiter and filter te Investigated impact of inserting state-of-the-art filters and op configuration.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
FY 2011 Base Plans:						
In FY 2011: Not Applicable.						

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVE 3600: Research, Development, Test BA 3: Advanced Technology Develop	& Evaluation	, Air Force		R-1 ITEM NO PE 0603112 Systems			or Weapon	PROJECT 6377SP: Ac	lvanced Spa	s	
C. Other Program Funding Summa Line Item • PE Not Provided (1248): Activity Not Provided	<mark>ary (\$ in Milli</mark> <u>FY 2009</u> 0.000	ions) FY 2010 0.000	FY 2011 Base 0.000	FY 2011 OCO 0.000	FY 2011 <u>Total</u> 0.000	<u>FY 2012</u> 0.000	<b>FY 2013</b> 0.000	<u>FY 2014</u> 0.000	<u>FY 2015</u> 0.000	<u>Cost To</u> <u>Complete</u> 0.000	Total Cost
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, RDT&E Budget Item	xhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force       I									ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develo	Test & Evaluation, Air Force PE 0603199F: Sustainment Science and Technology (S&T)										
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	0.000	2.943	2.935	0.000	2.935	5.876	6.858	9.746	9.715	Continuing	Continuing
635351: Technology Sustainment	0.000	2.943	2.935	0.000	2.935	5.876	6.858	9.746	9.715	Continuing	Continuing

#### <u>Note</u>

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, RDT&E Budget Item Justification: PB 2011 Air F	orce			DATE: F	ebruary 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)		TEM NOMENCLA 603199F: Sustain	ATURE ment Science and Tech	nology (S&T)	
B. Program Change Summary (\$ in Millions)					
	<u>FY 2009</u>	<u>FY 2010</u>	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	0.000	2.955	0.000	0.000	0.000
Current President's Budget	0.000	2.943	2.935	0.000	2.935
Total Adjustments	0.000	-0.012	2.935	0.000	2.935
<ul> <li>Congressional General Reductions</li> </ul>		0.000			
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000			
<ul> <li>Congressional Rescissions</li> </ul>	0.000	-0.012			
Congressional Adds		0.000			
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000			
Reprogrammings	0.000	0.000			
SBIR/STTR Transfer	0.000	0.000			
Other Adjustments	0.000	0.000	2.935	0.000	2.935

#### Change Summary Explanation

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

(U) C. Performance Metrics Under Development

Exhibit R-2A, RDT&E Project Just	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									ruary 2010	uary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)					IOMENCLA <sup>-</sup> 9F: Sustainn (S&T)		e and	<b>PROJECT</b> 635351: <i>Technology Sustainment</i>					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost		
635351: Technology Sustainment	0.000	2.943	2.935	0.000	2.935	5.876	6.858	9.746	9.715	Continuing	Continuing		

#### <u>Note</u>

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.

#### B. Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop, demonstrate, and transition system health prediction technologies. Conduct studies and analyses to "design" in sustainability into future applications.	0.000	1.473	1.475	0.000	1.475
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
FY 2010 Plans: 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					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603199F: Sustainment Science Technology (S&T)	e and	nd 635351: Technology Sustainment			
B. Accomplishments/Planned Program (\$ in Millions)	·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>health. Verify and validate real time material state awareness of airframe structural components. Demonstrate real time diagnost prediction model capability to support risk-based decision making assessment technologies into system data environment.</li> <li><i>FY 2011 Base Plans:</i> <ul> <li>In FY 2011: Continue to develop and demonstrate fatigue/correct algorithms for interpreting sensor data. Verify capability of state component health. Expand efforts to verify and validated real the for engine and airframe structural components. Continue to detechnologies and develop life prediction model capability to supprognostics. Incorporate health assessment technologies into setting the setting sensor data. The setting sense is the setting technologies and develop life prediction model capability to supprognostics. Incorporate health assessment technologies into setting the setting sense is the settin</li></ul></li></ul>	stic technologies and develop life ng and prognostics. Incorporate health osion diagnostics sensors and e of the art reasoners to assess ime material state awareness capability monstrate real time diagnostic oport risk based decision making and					
<ul> <li>MAJOR THRUST: Develop, demonstrate, and transition technologi maintenance, replacement, and concepts for performance improven <i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.</li> <li><i>FY 2010 Plans:</i> In FY 2010: Evaluate low maintenance materials and structura enhancement/replacement application concepts. Demonstrate integrity decision making. Demonstrate capability of certificatio implementation, and sustainment costs. Develop technology of systems via material substitution, process modification, nondest modeling and decision making to ensure full system operability.</li> </ul>	I concepts. Integrated structural life risk-based approach to structural n by analysis to reduce design time, ptions to improve sustainability of tructive inspection tools, and risk-based	0.000	0.490	0.480	0.000	0.480

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603199F: Sustainment Science Technology (S&T)	and	<b>PROJECT</b> 635351: <i>Te</i>			
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Evaluate low maintenance materials and structura enhancement/replacement application concepts. Demonstrate integrity decision making. Demonstrate capability of certificatio implementation, and sustainment costs. Assess technology op systems via material substitution, process modification, nondes modeling and decision making to ensure full system operability,	risk-based approach to structural n by analysis to reduce design time, tions to improve sustainability of tructive inspection tools, and risk-based					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
<ul> <li>MAJOR THRUST: Develop, demonstrate, and transition technologic components to decrease downtime, costs, and increase reliability.</li> <li><i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.</li> <li><i>FY 2010 Plans:</i> In FY 2010: Develop and demonstrate technologies that directly identified by evicting AF evictore.</li> </ul>	y respond to sustainment needs	0.000	0.980	0.980	0.000	0.980
<ul> <li>identified by existing AF systems. Evaluate methods to adjust workflow procedures and requirements to improve system avail management and operational sustainment. Demonstrate high r technologies. Demonstrate improved maintenance and repair technology solutions for future and existing system maintenance</li> <li><i>FY 2011 Base Plans:</i></li> <li>In FY 2011: Refine development and demonstration of technologies</li> </ul>	ability and reduce the cost of system reliability maintenance free repair data base systems. Demonstrate e issues.					
sustainment needs identified by existing AF systems. Evaluate maintenance, supply, and repair workflow procedures and requ	e technological means to adjust					

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Exhibit R-2A, RDT&E Project Ju	ustification: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET AC 3600: Research, Development, T BA 3: Advanced Technology Dev	est & Evaluation	, Air Force		<b>R-1 ITEM N</b> PE 0603199 <i>Technology</i>	F: Sustainm		and	<b>PROJECT</b> 635351: <i>Technology Sustainment</i>			
B. Accomplishments/Planned F	Program (\$ in M	lillions)									
-							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
and reduce the cost of syste maintenance free repair tech systems. Demonstrate tech <i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A	nnologies. Dem	ionstrate im	proved main	tenance and	repair data	base					
			Accomplish	ments/Plann	ed Program	s Subtotals	0.000	2.943	2.935	0.000	2.935
C. Other Program Funding Sun	nmary (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost
• PE 0602201F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Vehicle Technologies											
• PE 0603211F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology Dev/Demo											
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, RDT&E Budget Item	Justification	: PB 2011 A	ir Force						DATE: February 2010		
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 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	69.902	52.786	44.677	0.000	44.677	50.650	48.614	50.969	53.337	Continuing	Continuing
63665A: Advanced Aerospace Sensors Technology	19.832	27.175	22.996	0.000	22.996	24.446	22.571	23.656	24.755	Continuing	Continuing
6369DF: Target Attack and Recognition Technology	40.422	25.611	21.681	0.000	21.681	26.204	26.043	27.313	28.582	Continuing	Continuing
6388SP: Advanced Space Sensors	9.648	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### 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.

whibit R-2, RDT&E Budget Item Justification: PB 2011 Air F	orce			DATE:	February 2010	
PPROPRIATION/BUDGET ACTIVITY 000: Research, Development, Test & Evaluation, Air Force A 3: Advanced Technology Development (ATD)		EM NOMENCLA D3203F: Advanc	ATURE ed Aerospace Sensors			
Program Change Summary (\$ in Millions)						
	FY 2009	<u>FY 2010</u>	FY 2011 Base	FY 2011 OCO	FY 2011	
Previous President's Budget	65.115	51.482	0.000	0.000		0.000
Current President's Budget	69.902	52.786	44.677	0.000		4.677
Total Adjustments	4.787	1.304	44.677	0.000	44	4.677
Congressional General Reductions		-0.075				
Congressional Directed Reductions	0.000	0.000				
Congressional Rescissions	0.000	-0.221				
Congressional Adds     Congressional Directed Transfere		1.600				
<ul> <li>Congressional Directed Transfers</li> <li>Reprogrammings</li> </ul>	0.000	0.000 0.000				
SBIR/STTR Transfer	0.000	0.000				
Other Adjustments	4.787	0.000	44.677	0.000	1	4.677
·				Г		
Congressional Add Details (\$ in Millions, and Include		<u>ictions)</u>		_	FY 2009	FY 2010
Project: 63665A: Advanced Aerospace Sensors Techno	logy					
Congressional Add: Moving Target Strike.					1.995	0.000
Congressional Add: Precision Image Tracking and R	egistration.				1.596	0.000
		Cong	ressional Add Subtotals	for Project: 63665A	3.591	0.000
Project: 6369DF: Target Attack and Recognition Techno	logy			_		
Congressional Add: Active Unmanned Air Vehicle (U	AV) Phenomena	ology (AUP) & Al	RT Technology Transitio	n.	1.995	0.000
Congressional Add: Automated Sensor-Communicat	ion Response T	echnology.			1.596	0.00
Congressional Add: Reconfigurable Secure Computi	ng Technologies	5.		-	1.197	1.59
		Cong	ressional Add Subtotals	for Project: 6369DF	4.788	1.59

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: Advanced Aerospace Sensors	

#### **Change Summary Explanation**

Note: In FY 2010, Congress added \$1.6 million for Reconfigurable Secure Computing Technologies. The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

C. Performance Metrics Under Development.

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)					<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: Advanced Aerospace Sensors				<b>PROJECT</b> 63665A: Advanced Aerospace Sensors Technology			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
63665A: Advanced Aerospace Sensors Technology	19.832	27.175	22.996	0.000	22.996	24.446	22.571	23.656	24.755	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop electro-optical sensor technology to detect, locate, and identify air and ground targets at long ranges, including those that are low-observable, or use deception or camouflage.	4.259	3.979	1.317	0.000	1.317
FY 2009 Accomplishments: In FY 2009: Conducted 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. Characterized 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. Completed development of multispectral/polarimetric focal plane array device for enhanced low contrast target discrimination, and designed airborne sensor module for enhancement of multi-function demonstration system.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	uary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: Advanced Aerospace	Sensors	PROJECT 63665A: Ac Technology	lvanced Aero	ospace Sens	ensors	
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2010 Plans: In FY 2010: Complete end-to-end performance characterization, resolution, three-dimensional laser radar for high confidence targe spectral imaging for low false alarm rate detection utilizing change discrimination techniques. Continue design of airborne multispec long range target discrimination and integrated laser radar for lon and moving targets.	et identification coupled with passive e detection and spatial-spectral tral/polarimetric sensor module for						
FY 2011 Base Plans: In FY 2011: Perform concept validation and signature utility experimetric and synthetic aperture laser radar imaging. Continue with multispectral/polarimetric imaging systems to assess military experiments for mitigating primary risk areas associated with synthesis from airborne platforms.	e signature collection experiments utility. Initiate laboratory and field						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop technologies to maximize positional accu techniques to improve offensive and defensive combat capabilities.	racy, timing accuracy, and exploitation	1.819	0.700	1.232	0.000	1.232	
FY 2009 Accomplishments: In FY 2009: Demonstrated worldwide ultra-accurate positioning s sensitive targeting, battlespace awareness, persistent intelligenc capabilities. Developed multi-sensor phenomenology-based geo performed lab tests of multi-intelligence georegistration.	e, surveillance, and reconnaissance						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace</i>	R-1 ITEM NOMENCLATURE         PROJEC           PE 0603203F: Advanced Aerospace Sensors         63665A: A           Technolog         Technolog				
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 OCO	FY 2011 Total	
FY 2010 Plans: In FY 2010: Demonstrate optimized reference for precise emit way time transfer techniques. Explore feasibility and goals for multi-static radar application.						
FY 2011 Base Plans: In FY 2011: Develop reference optimization components neces radar technologies. Evaluate progress and determine next spin						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop light, low power, compact RF sensors the enable persistent ISR from unmanned aerial vehicles, and detect and		9.259	17.757	14.899	0.000	14.899
FY 2009 Accomplishments: In FY 2009: Demonstrated the radio-frequency sensors of an in frequency sensor suite for unmanned aerial vehicles with seve enable single platform persistent intelligence, surveillance, and with a system of systems architecture. Performed systems and target detection and tracking using cross-cued, dual-band rada sensors. Enhanced the modeling, simulation, and analysis tes optical sensing modes, and provided input into the required de radio-frequency sensor suite, including required data processir engineering support fostering the transition of developed enable weapon systems and intelligence, surveillance, and reconnaiss with the modeling, simulation, and analysis test bed providing intelligence experiment.	re size, weight, and power constraints to reconnaissance capabilities compatible alysis for improved air and ground r coupled with electronic support t bed with the inclusion of electro- sign for an integrated electro-optical/ and exploitation. Provided systems ing technologies and concepts to cance assets. Conducted experiments					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace Se</i>	ensors	<b>PROJECT</b> 63665A: Advanced Aerospace Sensors Technology					
B. Accomplishments/Planned Program (\$ in Millions)	'		•					
<b>_</b>	F	Y 2009	FY 2010	FY 2011         FY 2011         FY           FY 2010         Base         OCO         T				
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Continue demonstration of the radio-frequency seradar, X-band radar, electronic support sensors) of an integrate sensor suite for unmanned aerial vehicles with severe size, we enable persistent intelligence, surveillance, and reconnaissan system of systems architecture. Utilize the modeling, simulating radio-frequency and electro-optical sensing modes, to provide an integrated electro-optical/radio-frequency sensor suite, inclexploitation. Continue sensor systems engineering support for enabling technologies and concepts to weapon systems and i reconnaissance assets. Enhance the systems engineering to altitude, long-endurance sensor platform within a layered sense multi-intelligence sensor suite to improve detection and tracking or targets in urban areas. Initiate efforts to improve the capabilities or targets in urban areas. Initiate efforts to improve the capabilities or targets in urban areas. Initiate efforts to improve the capabilities or targets in urban areas. Initiate efforts to improve the capabilities or targets in urban areas. Initiate efforts to improve the capabilities or targets in urban areas. Initiate efforts to improve the capabilities or targets in urban areas. Initiate efforts to improve the capabilities or targets in urban areas. Initiate efforts to improve the capabilities or targets in urban areas. Initiate efforts to improve the capabilities or targets in urban areas. Initiate efforts to improve the capabilities or targets in urban areas. Initiate efforts to improve the capabilities or targets in urban areas. Initiate efforts to improve the capabilities or targets in urban areas. Initiate efforts to improve the capabilities or target response characteristics. Continue to improve the capabilities or target response characteristics. Continue to improve the capabilities of the target response characteristics. Continue to improve the capabilities areas the detection and tracking of airborne and ground to enhance the detection and tracking of airbor</li></ul>	ted electro-optical/radio-frequency eight, and power constraints to ce capabilities compatible with a on, and analysis test bed, including input into the required design for luding required data processing and ostering the transition of developed ntelligence, surveillance, and consider the optimal use of a high- sing architecture. Initiate effort using ng of difficult targets such as dismounts withites of passive sensing to enhance the with low radar cross section (including ronic counter-countermeasures. sensors (Ultra-High Frequency (UHF) ted electro-optical/radio-frequency eight, and power constraints to enable nce capabilities compatible with a simultaneous air and ground target mitter/receiver sensor operation to ad advanced high range resolution abilities of receivers in a passive							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace Se</i>	ensors	PROJECT 63665A: Advanced Aerospace Sensors Technology				
B. Accomplishments/Planned Program (\$ in Millions)	'						
	F	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
cross section (including dismounts), concealment capabilities, countermeasures. Emphasis is on low cost sensing capability to bolster system ubiquity.	or employment of electronic counter-						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop weapons guidance-quality track radar and advanced radar signal processing techniques to improve perfo		0.904	0.000	0.000	0.000	0.00	
FY 2009 Accomplishments: In FY 2009: Demonstrated the surveillance performance of he developed adaptive processing algorithms and waveforms in h clutter and jamming interference.							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop technologies to provide precision posi distributed, layered sensing on large air and space vehicles in GPS		0.000	2.131	3.969	0.000	3.96	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace</i>	R-1 ITEM NOMENCLATURE         PROJ           PE 0603203F: Advanced Aerospace Sensors         63665           Techn         7				
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Design reduced size, weight, and power precision techniques for space-based, airborne, and ground-based appl systems engineering model to assess assured reference techn performance and warfighter utility. Enhance multi-ship virtual assess world-wide distributed position, navigation, and timing enabling distributed, layered sensing.	ications. Demonstrate constructive hiques in terms of measures of flight test simulation technology to					
FY 2011 Base Plans: In FY 2011: Design reduced size, weight, and power for preci consisting of a single integrated GPS and inertial sensor for st characteristic of small unmanned aerial systems appropriate for demonstration through a constructive systems engineering mo techniques in terms of measures of performance and warfighter	ringent installation requirements or distributed, layered sensing. Continue odel to assess assured reference					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop infrared surveillance technologies for a targets in urban areas from high altitude UAV and manned platform		0.000	0.949	1.579	0.000	1.579
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Initiate an effort to perform design studies and co exploiting novel temporal, spectral, and polarimetric discrimina detect, locate, identify, and characterize battlefield targets and	ation based on infrared sensors to rapidly					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace</i>	R-1 ITEM NOMENCLATURE       PRO         PE 0603203F: Advanced Aerospace Sensors       636         Tec       700				
B. Accomplishments/Planned Program (\$ in Millions)	·		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Initiate concept demonstration experiments, begi for exploiting novel temporal, spectral, and polarimetric discrin to rapidly detect, locate, identify, and characterize battlefield ta Leverage large format, infrared focal plane array technology d development projects and assess utility for high altitude and s	nination based on infrared sensors argets and events in urban areas. leveloped under other component					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Reduce technology risk for space sensor platfor of infrastructure integration.	orm payload components and exploitation	0.000	1.659	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
<i>FY 2010 Plans:</i> In FY 2010: Develop Mission Design Tool kit and experimenta payloads) sensors. Begin to address PnP (Plug and Play) co						
FY 2011 Base Plans: In FY 2011: Not Applicable. Effort eliminated due to higher A	ir Force priorities.					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
	mplishments/Planned Programs Subtotals	16.241	27.175	22.996	0.000	22.99

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVI 3600: Research, Development, Test BA 3: Advanced Technology Develop	& Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603203			Sensors	PROJECT 63665A: Ac Technology	lvanced Aero	ospace Sens	sors
B. Accomplishments/Planned Prog	gram (\$ in N	lillions)						1			
							FY 2009	FY 2010	]		
Congressional Add: Moving Target	Strike.						1.995	0.000			
FY 2009 Accomplishments: In FY 2009: Conducted Congre	ssionally-dir	ected effort f	or Moving T	arget Strike.							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
Congressional Add: Precision Image	e Tracking a	nd Registrati	on.				1.596	0.000	-		
FY 2009 Accomplishments: In FY 2009: Conducted Congre FY 2010 Plans:	ssionally-dir	ected effort f	or Precision	Image Tracl	king and Re	gistration.					
In FY 2010: Not Applicable.											
				Congre	ssional Add	s Subtotals	3.591	0.000			
C. Other Program Funding Summa	nry (\$ in Mill	ions <u>)</u>							-		
			<u>FY 2011</u>	<u>FY 2011</u>	FY 2011					Cost To	
Line Item	FY 2009	FY 2010	Base	000	<u>Total</u>	FY 2012	FY 2013	FY 2014		Complete	
• PE Not Provided (1862): Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0602204F: Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603205F: <i>Flight Vehicle</i> <i>Technology.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603707F: Weather Systems Advanced Development.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
	<b>PROPRIATION/BUDGET ACTIVITY</b> 00: Research, Development, Test & Evaluation, Air Force 3: Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE         PROJ           PE 0603203F: Advanced Aerospace Sensors         63665           Techn         Techn			lvanced Aero	ospace Sens	sors
C. Other Program Funding Summa	ary (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	<u>000</u>	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost
• PE 0603500F: Multi-Disciplinary	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Advanced Development Space											
Technology.											
• PE 0602111N: Weapons	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology.											
• PE 0602232N: Space and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Electronic Warfare (SEW)											
Technology.											
• PE 0604249F: LANTIRN Night	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Precision Attack.											
• PE 0603270F: <i>Electronic</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Combat Technology.											

#### **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, RDT&E Project Justification: PB 2011 Air Force						DATE: February 2010					
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 3: Advanced Technology Devel	st & Evaluatio	,		R-1 ITEM NOMENCLATURE         PROJECT           PE 0603203F: Advanced Aerospace Sensors         6369DF: Target Attack and Recognition           Technology         7				and Recogni	Recognition		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
6369DF: Target Attack and Recognition Technology	40.422	25.611	21.681	0.000	21.681	26.204	26.043	27.313	28.582	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.

#### B. Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
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.	0.945	0.098	0.000	0.000	0.000
<i>FY 2009 Accomplishments:</i> In FY 2009: Provided support to the transition of the moving target algorithm technology to operational strike and reconnaissance platforms.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace Se</i>	ensors	<b>PROJECT</b> 6369DF: Ta Technology	rget Attack a	and Recogni	tion
B. Accomplishments/Planned Program (\$ in Millions)						
	F	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Complete the transition of moving target algorithm teo reconnaissance platforms.	hnology to operational strike and					
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and assess multi-sensor automatic target r surveillance, reconnaissance, strike, and weapon systems.	ecognition for intelligence,	2.478	1.950	3.077	0.000	3.077
FY 2009 Accomplishments: In FY 2009: Conducted spiral development and assessment of murrecognition fusion algorithms. Conducted assessment of technologi surveillance, reconnaissance, strike, and weapon systems using the recognition test and evaluation facility. Conducted spiral developming generation capability critically needed to augment collected researed data sets. Developed automatic target recognition fusion sensor development of an optimum data fusion exploitation capability. En target recognition test and evaluation facility and data sets as required target recognition fusion capabilities. Determined technology short target recognition fusion technologies to overcome these shortfalls	gy supporting intelligence, he Air Force automatic target hent and validation of synthetic data ch, development, and operational ata exploitation capability utilizing indence of features to support hanced the Air Force automatic ired to support enhanced automatic tfalls and developed automatic					
FY 2010 Plans: In FY 2010: Continue spiral development and assessment of multi fusion algorithms. Continue assessment of technology supporting						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace</i>	Sensors	PROJECT 6369DF: Ta Technology	69DF: Target Attack and Recognitior		
B. Accomplishments/Planned Program (\$ in Millions)	'		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
reconnaissance, strike, and weapon systems using the Air Ford evaluation facility. Continue spiral development and validation critically needed to augment collected research, development, development of an automatic target recognition fusion sensor of analysis and experimentation of data independence and interde development of an optimum data fusion exploitation capability. target recognition test and evaluation facility and data sets as n target recognition fusion capabilities. Determine technology sh recognition fusion technologies to overcome these shortfalls. E technology developed to date. <i>FY 2011 Base Plans:</i> In FY 2011: Continue spiral development and assessment of n fusion algorithms. Continue assessment of technology support reconnaissance, strike, and weapon systems using the Air Ford evaluation facility. Continue spiral development and validation critically needed to augment collected research, development, development of an automatic target recognition fusion sensor of analysis and experimentation of data independence and interded development of an optimum data fusion exploitation capability. target recognition test and evaluation facility and data sets as n target recognition fusion capabilities. Determine technology sh recognition fusion technologies to overcome these shortfalls. E technology developed to date.	of synthetic data generation capability and operational data sets. Continue ata exploitation capability utilizing ependence of features to support Enhance the Air Force automatic equired to support enhanced automatic ortfalls and develop automatic target execute a laboratory demonstration of multi-sensor automatic target recognition ing intelligence, surveillance, ee automatic target recognition test and of synthetic data generation capability and operational data sets. Begin on database development. Continue ata exploitation capability utilizing ependence of features to support Enhance the Air Force automatic equired to support enhanced automatic ortfalls and develop automatic target					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace</i>	e Sensors	PROJECT 6369DF: Ta Technology	arget Attack a	and Recogni	tion
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate a moderate-confidence and advanced cueing capability for stationary and moving targets.	ce automatic target recognition (ATR)	7.975	2.778	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Incorporated improvements in the initial design of improved detection that were previously evaluated. Incorporate of the three-dimensional laser-detection-and-ranging automatic were previously evaluated. Incorporated improvements in the algorithms that were previously evaluated. Incorporated improvements in the sensor management suite that were previously evaluated. Incorporated set of laser sensor exploitation tools that were previously evaluated recognition evaluation test facility and data sets as necessary to	ed improvements in the initial design target recognition algorithms that initial design of the laser vibrometry vements in the initial design of the prporated improvements in the initial ated. Enhanced automatic target					
FY 2010 Plans: In FY 2010: Develop an electro-optic enhanced automatic targ improvements provided by the multi-sensor fusion algorithms, if and-ranging automatic target recognition algorithms that were vibrometry algorithms and the sensor management suite that we laser sensor exploitation tools as required to support spiral ATF target recognition evaluation test facility and data sets as neces	the three-dimensional laser-detection- previously evaluated, the laser vere previously evaluated. Enhance R development. Enhance automatic					
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate an automatic target readvanced geo-registration techniques and innovative change detection		1.618	1.035	2.193	0.000	2.193

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Determined need to continue spiral assessment and d recognition, automatic target cueing, geo-registration, and change of assessment of technology supporting time-critical targeting systems recognition test and evaluation facility. Conducted spiral developming generation capability critically needed to augment collected research data sets. Demonstrated time-critical targeting, advanced target tra- maintenance capabilities. Enhanced the Air Force automatic target facility and data sets as required to support enhanced time-critical targeting a technologies to overcome these shortfalls.	detection technology. Conducted s in the Air Force automatic target ent and validation of synthetic data sh, development, and operational acking and multi-sensor track t recognition test and evaluation argeting capabilities. Determined					
FY 2010 Plans: In FY 2010: Assess performance of developed technology and developed recognition, automatic target cueing, geo-registration, and chevarighter needs. Continue assessment and enhancement of technologies systems in the Air Force automatic target recognition test spiral development and validation of synthetic data generation capacities collected research, development, and operational data sets. Enhance recognition test and evaluation facility and data sets as required to stargeting capabilities. Continue spiral development and assessment targeting and advanced target tracking technologies required to metal.	ange detection technology to meet nology supporting time-critical and evaluation facility. Continue ability critically needed to augment nce the Air Force automatic target support enhanced time-critical nt development of time-critical					
FY 2011 Base Plans: In FY 2011: Determine state of the art technology capabilities and s to automatic target recognition, automatic target cueing, geo-registr technology to meet warfighter needs. Continue assessment and er supporting time-critical	ation, and change detection					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace</i>	Sensors		<b>PROJECT</b> 6369DF: Target Attack and Recognition Technology		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
targeting systems in the Air Force automatic target recognition spiral development and validation of synthetic data generation collected research, development, and operational data sets. E recognition test and evaluation facility and data sets as require targeting capabilities. Continue spiral development and assess advanced target tracking technologies required to meet warfigh demonstration of technology developed to date.	capability critically needed to augment nhance the Air Force automatic target d to support enhanced time-critical sment of time-critical targeting and					
FY 2011 OCO Plans: In FY 2011 OCO: N/A. MAJOR THRUST: Develop an "identify friend, foe, or neutral" air-to	around canability using cooperative and	2.921	1.387	1.018	0.000	1.01
non-cooperative identification techniques.	-ground capability using cooperative and	2.521	1.507	1.010	0.000	1.01
FY 2009 Accomplishments: In FY 2009: Integrated and demonstrated improved ground tar enhanced target databases, identification algorithm advanceme operational environment. Assessed performance of technology operational systems. Conducted refinement of identification algorithm necessary to support transition of technology.	ents, and radio-frequency tags in an y to support warfighter integration with					
FY 2010 Plans: In FY 2010: Integrate, demonstrate, and assess, in an operation ground target identification capabilities through enhanced target advancements, and radio-frequency tags. Determine enhanced performance of these technologies to support warfighter needs algorithms, target databases, and exploitation tools as necessar	et databases, identification algorithm ments required to attain the required . Continue refinement of identification					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace</i>	e Sensors	<b>PROJECT</b> 6369DF: <i>Target Attack and Recognitic</i> <i>Technology</i>			tion
B. Accomplishments/Planned Program (\$ in Millions)	I		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans: In FY 2011: Begin development of physics-based signature existing a processing for feature-based recognition and fusion and to enable performance-based sensing. Begin development of exploitation and signal processing analysis capability for recognadar, Combat Identification (CID), Space Situational Awarene Intelligence (MASINT), and ISR applications. Develop efficient radar sensor data for recognition. Begin development of methor in the prediction, analysis, and processing capability as a funct performance-driven sensing. Develop a loosely coupled capability and MASINT applications.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A.</li> </ul>	apply these methods to sensor design an integrated radar sensor signature nition applications including staring ss, Measurement and Signatures t methods for collecting and processing ods to analyze salient features to aid ion of sensor design parameters for pility for multi-sensor measurement,					
MAJOR THRUST: Develop wide angle, persistent, multi-sensor/wa exploitation technology to detect, track, and identify targets over lar <i>FY 2009 Accomplishments:</i> In FY 2009: Designed and developed engineering models of t angle, continuously-staring capability building upon the techno component stage. Integrated and demonstrated the wide angl technologies. Assessed the maturity of the technology via a co analyses in the Air Force automatic target recognition test and development of wide angle, continuous staring exploitation alg	ge areas at low sensor update rates. he multi-sensor, multi-wavelength wide- logies developed during the individual e, continuously-staring component ombination of exercises and scientific evaluation facility. Initiated spiral	7.117	6.535	9.241	0.000	9.24

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
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B. Accomplishments/Planned Program (\$ in Millions)	· · · ·		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
of the Air Force interest item to develop electro-optical, infrare sensor technologies and algorithms.	d, and synthetic aperture radar staring-					
<ul> <li>FY 2010 Plans: In FY 2010: Develop, integrate, and test the next spiral engine wavelength wide-angle, continuously-staring capability buildin during the individual component stage. Integrate, demonstrat wide angle, continuously-staring component technologies via analyses in the Air Force automatic target recognition test and development of wide angle, continuous staring exploitation alg target and scenario databases necessary to support transition militarily significant scenario, evaluate results and plan for transition militarily significant scenario, evaluate results and plan for transition for FY 2011 Base Plans: In FY 2011: Develop, integrate and test to technology reading engineering model of the multi-sensor, multi-wavelength wide- building upon the technologies developed during the previous and test the enhanced, TRL level 5, wide angle, continuously-stari combination of exercises and scientific analyses in the Air For and evaluation facility. Continue spiral development of wide a algorithms, phenomenological modeling, target and scenario of transition to the warfighter. Increase TRL to 5 and demonstrate evaluate results and begin transition.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A.</li> </ul>	g upon the technologies developed e, and test the enhanced, spiral two, a combination of exercises and scientific d evaluation facility. Continue spiral gorithms, phenomenological modeling, to the warfighter. Demonstrate in a hsition. ess level (TRL) 5, the next spiral -angle, continuously-staring capability demonstration. Integrate, demonstrate ng component technologies via a ree automatic target recognition test angle, continuous staring exploitation databases necessary to support					
		12.580	9.854	6.048	0.000	6.048

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop an advanced suite of sensors with automatarget tracking, all working in concert to provide a high-confidence identity						
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Designed and tested an advanced aimpoint tracking of automatic target recognition capability using electro-optical sensor synthetic aperture radar automatic target recognition capability to of exploitation of synthetic aperture radar data. Developed an advance and exploitation results from multiple sensors. Conducted spiral hid development of algorithm phenomenological modeling, target and support technology development. Assessed maturity of technology Air Force automatic target recognition test and evaluation facility at FY 2010 Plans:</li> </ul>	data. Built upon previous develop a high confidence ced capability to fuse information gh confidence identification scenario databases necessary to y during the spiral process via the nd other sensor test facilities.					
In FY 2010: Integrate the advanced aimpoint tracking, electro-opti synthetic aperture radar automatic target recognition and the multi- integrated system and develop the second spiral requirements. Er target and scenario databases and exploitation tools necessary to development. Assess maturity of technology during the spiral proc target recognition test and evaluation facility and other sensor test	esensor fusion algorithms. Test the nhance phenomenological modeling, support spiral two technology cess via the Air Force automatic					
FY 2011 Base Plans: In FY 2011: Identify candidate technologies to improve aimpoint t target recognition, synthetic aperture radar automatic target recogr fusion algorithms. Predict performance of the integrated technolog phenomenological modeling, target and scenario databases and ex support technology development. Assess maturity of applicable te automatic target recognition test and evaluation facility and other s	nition and the multi-sensor gies and system. Enhance xploitation tools necessary to echnology during the Air Force					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: <i>Advanced Aerospace</i>	e Sensors	PROJECT 6369DF: Ta Technology	DF: Target Attack and Recognition			
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Investigate airborne techniques and algorithms for scharacterization, and airborne technology for multi-sensor data fusion f		0.000	0.381	0.104	0.000	0.104	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Initiate an effort to process multiple sources of ground data on various space objects using upgraded space object ID algo upgrades to a space object ID database.							
FY 2011 Base Plans: In FY 2011: Begin spiral development and assessment of multi-se automatic target recognition fusion algorithms. Assess technology in the Air Force automatic target recognition test and evaluation far and validation of synthetic data generation capability critically needed t development, and operational data sets. Critically examine target independence and interdependence of features to support develop	supporting space object recognition cility. Continue spiral development o augment collected research, and scenario data to determine						
exploitation capability. Incorporate enhanced Space Object Identifi space situational awareness experiments. Continue enhancement recognition test and evaluation facility and data sets as required to awareness automatic target recognition fusion capabilities.	cation models into advanced t of the Air Force automatic target						
FY 2011 OCO Plans: In FY 2011 OCO: N/A.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Acco	omplishments/Planned Programs Subtotals	35.634	24.018	21.681	0.000	21.68
		FY 2009	FY 2010	]		
Congressional Add: Active Unmanned Air Vehicle (UAV) Phenom Transition.	enology (AUP) & ART Technology	1.995	0.000			
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Ac Phenomenology (AUP) & ART Technology Transition.	tive Unmanned Air Vehicle (UAV)					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
Congressional Add: Automated Sensor-Communication Respons	e Technology	1.596	0.000			
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Au Response Technology.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
		1.197	1.593			

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APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>R-1 ITEM NO</b> PE 0603203	-	-	Sensors	<b>PROJECT</b> 6369DF: Target Attack and Re Technology			ition
B. Accomplishments/Planned Prog	gram (\$ in M	illions)						1			
							FY 2009	FY 2010			
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Conducted Congress</li> <li>Technologies.</li> <li>FY 2010 Plans:</li> <li>In FY 2010: Conduct Congressi</li> <li>Technologies</li> </ul>			-			g					
Technologies.				Congre	ssional Add	s Subtotals	4.788	1.593			
C. Other Program Funding Summa	•		<u>FY 2011</u>	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	<u>FY 2010</u>	Base	000	<u>Total</u>	FY 2012	FY 2013	<u>FY 2014</u>		Complete	
• PE 0602204F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<ul><li>PE 0603253F: Advanced Sensor</li></ul>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Integration.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603500F: <i>Multi-Disciplinary</i> Advanced Space Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603762E: Sensor and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Guidance Technology.											
• PE 0603270F: Electronic	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Combat Technology.											
• PE Not Provided (2391): Theater Missile Defense System Program Office.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE Not Provided (2403): Low Altitude Night Targeting and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010				
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C. Other Program Funding Sumn	nary (\$ in Mill	ions <u>)</u>											
Line Item Infrared Navigation (LANTIRN) System Program Office.	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u> <u>Base</u>	<u>FY 2011</u> <u>OCO</u>	<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>		
<b>D. Acquisition Strategy</b> Not Applicable.													
<b><u>E. Performance Metrics</u></b> Please refer to the Performance E Force performance goals and mo	•				/ Air Force re	esources are	applied an	nd how those	resources a	ire contributi	ng to Air		

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force							DATE: Feb	ruary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>R-1 ITEM N</b> PE 0603203	IOMENCLA <sup>-</sup> 3F: <i>Advance</i>		<b>PROJECT</b> 6388SP: Advanced Space Sensors				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
6388SP: Advanced Space Sensors	9.648	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### <u>Note</u>

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; electrooptical 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Reduce technology risk for space sensor platform payload components and exploitation of infrastructure integration.	0.789	0.000	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Developed "plug-and-play" satellite critical experiment, to including full simulation.					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.					
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
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B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop technologies for global positioning sys accuracy, and exploitation techniques to improve offensive and de		2.065	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Demonstrated space-based distributed position, to achieve optimal sensor fusion for distributed, layered sense flight test simulation technology to assess world-wide distributed architectures for disparate platforms across distributed, layered	ng. Demonstrated multi-ship virtual ed position, navigation, and timing						
FY 2010 Plans: In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop electro-optical sensor component tech mission areas. Develop new sensor components, topologies and		1.428	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Completed experimental space flight of sensor concompleted data collection, testing, and system evaluation. In embedded satellite components.	•						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603203F: Advanced Aerospac	ce Sensors	<b>PROJECT</b> 6388SP: <i>A</i>	dvanced Spa	ce Sensors	
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
FY 2011 Base Plans: In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop advanced laser communication composupport a network-level topology for airborne intelligence, surveilla		4.724	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Matured technologies for integration into airborne Conducted further ground and flight tests of laser communicat Free Space Optical Modem focusing on compact packaging for installations. Integrated Optical terminal with RF communicati free space optical and radio-frequency communications termin Reconnaissance (ISR) relay missions. Demonstrated hybrid f failsafe/failback operations in airborne tests. This effort ended	ion system. Developed advanced or Airborne Terminal Rack (ATR) rack ons gear to enable testing of hybrid nal for Intelligence Surveillance and ree space optical/radio frequency					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVI 3600: Research, Development, Test BA 3: Advanced Technology Develop	& Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603203			<b>PROJECT</b> 6388SP: <i>Advanced Space Sensors</i>				
B. Accomplishments/Planned Prog	gram (\$ in M	illions)									
		·					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop a geode reflector antennas. Improve operation		•	•	•		r current	0.642	0.000	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Fully characterized with operational satellites. This		•	•	ator sub-sect	or and demo	onstrate					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
FY 2011 Base Plans: In FY 2011: Not Applicable.											
FY 2011 OCO Plans: In FY 2011 OCO: N/A.											
			Accomplish	ments/Plann	ed Program	s Subtotals	9.648	0.000	0.000	0.000	0.00
C. Other Program Funding Summa	ary (\$ in Mill	ons)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					Cost To	
Line Item	FY 2009	<u>FY 2010</u>	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<b>Complete</b>	Total Cos
• PE Not Provided (2596): Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
• PE 0602204F: Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602500F: <i>Multi-Disciplinary Space Technology.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				UNCLAS							

				ONOLAC							
Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVI 6600: Research, Development, Test 3A 3: Advanced Technology Develop	& Evaluation			<b>R-1 ITEM N</b> PE 0603203			Sensors	<b>PROJECT</b> 6388SP: Advanced Space Sensors			
C. Other Program Funding Summa	ry (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
<u>Line Item</u> PE 0603500F: <i>Multi-Disciplinary</i> Advanced Development Space Technology.	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	<u>0C0</u>	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Co
<ol> <li>Acquisition Strategy Not Applicable.</li> </ol>											

Exhibit R-2, RDT&E Budget Item	Justification	: PB 2011 A	ir Force						DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>R-1 ITEM NOMENCLATURE</b> PE 0603211F: Aerospace Technology Dev/Demo								
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
Total Program Element	41.748	88.226	53.588	0.000	53.588	56.480	58.124	58.384	60.306	Continuing	Continuing	
63486U: Advanced Aerospace Structures	1.197	11.700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing	
634920: Flight Vehicle Tech Integration	40.551	76.526	53.588	0.000	53.588	56.480	58.124	58.384	60.306	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 weapon 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 2009	<u>FY 2010</u>	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	45.990	76.844	0.000	0.000	0.000
Current President's Budget	41.748	88.226	53.588	0.000	53.588
Total Adjustments	-4.242	11.382	53.588	0.000	53.588
<ul> <li>Congressional General Reductions</li> </ul>		0.000			
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000			
<ul> <li>Congressional Rescissions</li> </ul>	0.000	-0.368			
<ul> <li>Congressional Adds</li> </ul>		11.750			
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000			
<ul> <li>Reprogrammings</li> </ul>	0.000	0.000			
SBIR/STTR Transfer	0.000	0.000			
Other Adjustments	-4.242	0.000	53.588	0.000	53.588

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	DA	TE: February 201	C
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603211F: <i>Aerospace Technology Dev/Demo</i>		
Congressional Add Details (\$ in Millions, and Includes Ger	eral Reductions)	FY 2009	FY 2010
Project: 63486U: Advanced Aerospace Structures			
Congressional Add: Big Antennas Small Structures Efficient	nt Tactical (BASSET) Unmanned Air Vehicles.	1.197	1.593
Congressional Add: 3D Bias Woven Preform Development	t	0.000	2.390
Congressional Add: Long-Loiter, Load Bearing Antenna Pl	atform for Pervasive Airborne Intelligence	0.000	3.983
Congressional Add: Program Increase		0.000	3.734
	Congressional Add Subtotals for Project: 6348	SU 1.197	11.700
	Congressional Add Totals for all Proje	ts 1.197	11.700

## **Change Summary Explanation**

Note 1: The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

Note 2: In FY 2010, Congress added \$1.59 million for Big Antennas Small Structures Efficient Tactical Unmanned Air Vehicles, \$2.39 million for 3D Bias Woven Preform Development, \$1.59 million for Long-Loiter, Load Bearing Antenna Platform for Pervasive Airborne Intelligence, and \$3.73 million for Program Increase.

(U) C. Performance Metrics Under Development

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Exhibit R-2A, RDT&E Project Ju	stification: Pl	3 2011 Air F	orce						DATE: Feb	oruary 2010	
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te 3A 3: Advanced Technology Deve	st & Evaluatio				<b>IOMENCLA</b> 1F: <i>Aerospa</i>	TURE ce Technolog	<b>PROJECT</b> 63486U: <i>Advanced Aerospace Structures</i>				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
63486U: Advanced Aerospace Structures	1.197	11.700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuir
3. Accomplishments/Planned Pl	rogram (\$ in I	<u>Willions)</u>					FY 2009	FY 2010	]		
							1.197	1.593	-		
Congressional Add: Big Antennas FY 2009 Accomplishments: In FY 2009: Conducted Cong tactical unmanned air vehicle	gressionally di		,	,							
FY 2010 Plans: In FY 2010: Conduct Congre unmanned air vehicles.	essionally direc	cted effort in	big antenna	s small struc	tures efficie	nt tactical					
Congressional Add: 3D Bias Wov	ven Preform D	evelopment					0.000	2.390			
FY 2009 Accomplishments: In FY 2009: Not Applicable.											

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603211F: <i>Aerospace Technolog</i> <i>Demo</i>	y Dev/	<b>PROJECT</b> 63486U: <i>A</i>	dvanced Aerospace Structures
B. Accomplishments/Planned Program (\$ in Millions)	'		1	
		FY 2009	FY 2010	
FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort in 3D ba	ais woven preform development.			
Congressional Add: Long-Loiter, Load Bearing Antenna Platform	for Pervasive Airborne Intelligence	0.000	3.983	3
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort in long- pervasive airborne intelligence.	loiter, load bearing antenna platform for			
Congressional Add: Program Increase		0.000	3.734	-
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort in progr	am increase.			

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVI 3600: Research, Development, Test BA 3: Advanced Technology Develop	, Development, Test & Evaluation, Air Force PE 0603211F: Aerospace Technology Dev/ 63486U: Advanced Aerospace Structure								ctures		
C. Other Program Funding Summa	ry (\$ in Mill	ions <u>)</u>	FY 2011	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	FY 2010	Base	000	Total	FY 2012	FY 2013	FY 2014	FY 2015		Total Cost
• PE Not Provided (2888): Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000	
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, RDT&E Project Ju	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force										
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)					I <b>OMENCLA</b> 1F: <i>Aerospa</i>	TURE ce Technolog	gy Dev/	<b>PROJECT</b> 634920: Flight Vehicle Tech Integration			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
634920: Flight Vehicle Tech Integration	40.551	76.526	53.588	0.000	53.588	56.480	58.124	58.384	60.306	Continuing	Continuing

#### <u>Note</u>

Note: Increased funding in FY 2010 is due to FY 2008 emphasis being placed on flight demonstration efforts of an X-type composite cargo aircraft. Decreased funding in FY 2011 is due to higher Air Force priorities.

## 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 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop autonomous flight controls for safe flight and cooperative operations between manned and unmanned air platforms.	6.485	8.573	13.197	0.000	13.197
FY 2009 Accomplishments: In FY 2009: Conducted ground demonstrations of situational awareness and control technologies for unmanned air vehicles operating in and around air bases. Developed and demonstrated cooperative teaming of small unmanned air vehicles in complex, low altitude environments. Conducted evaluation of validation and verification tools and process for affordable certification of autonomous unmanned air vehicle flight control software.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603211F: <i>Aerospace Technolog</i> <i>Demo</i>	gy Dev/	<b>PROJECT</b> 634920: <i>Fli</i>	<b>T</b> Flight Vehicle Tech Integration			
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2010 Plans: In FY 2010: Further the development and demonstration of situation control, and survivability technologies for manned and unmanned at and demonstration of cooperative teaming of small unmanned air wenvironments. Continue development of autonomous launch, reconsistent reconstruction of technologies for unmanned systems. Extend adaption control technology for use in reusable launch systems.</li> <li>FY 2011 Base Plans: In FY 2011: Further the development and demonstration process to autonomous control, and survivability technologies for manned and demonstration process to autonomous control, and survivability technologies for manned and demonstration process to autonomous control, and survivability technologies for manned and demonstration process to autonomous control, and survivability technologies for manned and demonstration process to autonomous control, and survivability technologies for manned and demonstration process to autonomous control, and survivability technologies for manned and demonstration process to autonomous control, and survivability technologies for manned and demonstration process to autonomous control, and survivability technologies for manned and demonstration process to autonomous control, and survivability technologies for manned and demonstration process to autonomous control process to autonomous control</li></ul>	air vehicles. Continue development vehicles in complex, low altitude overy, and safe airspace tive guidance, navigation, and for situational awareness,						
development and demonstration of cooperative teaming of small up low altitude environments. Continue development of autonomous interoperability technologies for multiple unmanned systems. Con guidance, navigation, and control technology for use in reusable la	nmanned air vehicles in complex, launch and safe airspace atinue development of adaptive						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop, simulate, and demonstrate integrated tech of manned and unmanned platforms.	nnologies to improve the performance	12.772	32.108	0.567	0.000	0.567	
FY 2009 Accomplishments: In FY 2009: Completed flight demonstration of extensive laminar Conducted and completed flight demonstration of an X-type aircraf for weight reduction, surface smoothness, corrosion, and fatigue et of a simulation environment to enable evaluation of network centric capabilities for high speed operational concepts.	ft comprised of advanced materials limination. Continued development						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603211F: <i>Aerospace Technolog</i> <i>Demo</i>	gy Dev/	<b>PROJECT</b> 634920: <i>Fli</i> g	ROJECT 4920: Flight Vehicle Tech Integration		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Continue work to develop and demonstrate flow of and enhancing weapon separation from future strike platforms environment to enable evaluation of network centric technolog speed operational concepts. Conduct flight demonstration effor composite wings.	. Continue development of a simulation ies for improved capabilities for high					
FY 2011 Base Plans: In FY 2011: Continue work to develop and demonstrate flow of enhancing weapon separation from future strike platforms.	control for reducing acoustic loading and					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop aircraft structures that have embedded been separate components that were attached to the air platforms.		13.160	15.349	21.204	0.000	21.20
FY 2009 Accomplishments: In FY 2009: Completed and assessed test results from the flig electronically scanned antenna array embedded in a load-bea						
FY 2010 Plans: In FY 2010: Complete assessment of test results from the flight electronically scanned antenna array embedded in a load-bear assess results of ultra lightweight multi-functional airframes. D Intelligence, Surveillance, and Reconnaissance technologies.	ring structure. Demonstrate and					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603211F: Aerospace Technolog Demo	gy Dev/	<b>PROJECT</b> 634920: Flight Vehicle Tech Integ			ion
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans: In FY 2011: Continue assessment of test results from the grour scanned antenna array embedded in a load-bearing structure. It assessment, and ground testing of antenna integration into load function structures that provide for increased Intelligence, Surve and reduced system size, weight, and power requirements. Confor antenna integration into load-bearing structures. Initiate dem unitized multi-role structures. Demonstrate key high altitude per Reconnaissance technologies.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	Continue the development, evaluation, -bearing structures to create multi- illance, and Reconnaissance capability ntinue flight test experimentation efforts nonstration efforts for reliability of					
MAJOR THRUST: Develop adaptive structures to provide in-flight m performance over a wide range of flight conditions and mission profil <i>FY 2009 Accomplishments:</i> In FY 2009: Demonstrated passive and active thermal protection speed vehicle components. Assessed results from demonstrated concepts integrating active aeroelastic design concepts and adaptive	es. on systems for leading edge of high- ons of advanced efficient wings	8.134	16.264	11.064	0.000	11.064
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Demonstrate passive and active thermal protection speed vehicle components. Continue assessment of results fro efficient wing concepts integrating active aeroelastic design con Demonstrate and assess rapid operability, maintainability, and s reusable hypersonic vehicles. Demonstrate and assess integrational bearing composite tanks and wing structures. Demonstrate laser concepts for flight class, weight, and performance.</li> </ul>	systems for leading edge of high- m demonstrations of advanced cepts and adaptive structures. support capabilities of conceptual ted structural health management for					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603211F: Aerospace Technolog Demo	gy Dev/	<b>PROJECT</b> 634920: <i>Fli</i>	<b>F</b> Flight Vehicle Tech Integration			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 Base Plans: In FY 2011: Further demonstrate passive and active thermal pr of high-speed vehicle components. Demonstrate and assess ra support capabilities of conceptual reusable hypersonic vehicles. structural health management for lightweight unmanned air vehi speeds. Demonstrate and assess integrated structural health m tanks and wing structures. Develop and assess detailed integra concepts for operationally responsive space lift.	pid operability, maintainability and Demonstrate and assess integrated cles from subsonic to hypersonic nanagement for load bearing composite						
FY 2011 OCO Plans: In FY 2011 OCO: N/A							
MAJOR THRUST: Develop, simulate, and demonstrate integrated to performance of high-speed and hypersonic manned and unmanned		0.000	4.232	7.556	0.000	7.556	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Develop and demonstrate hypersonic ablation shap prediction capabilities for carbon/carbon materials and low-temp apply these methods to understand shape change for upcoming prompt global reach concepts under development. Conduct risk aeromechanics, propulsion integration, controls, and hot structur propulsion demonstration program.	berature material analogues and high-speed tests and other current creduction research in the areas of						
FY 2011 Base Plans: In FY 2011: Continue efforts to develop and demonstrate hyper measurement and prediction capabilities for carbon/carbon mate							

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, _, _, _, _, _, _, _, _, _, _, _, _, _,		2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 600: Research, Development, Test 3A 3: Advanced Technology Develop	& Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603211 <i>Dem</i> o			y Dev/	<b>PROJECT</b> 634920: <i>Fli</i> g	ght Vehicle 1	Fech Integrat	ion
3. Accomplishments/Planned Pro	gram (\$ in M	lillions)	I								
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
aeromechanics, propulsion inte propulsion demonstration progr prediction methods for hyperson prompt global reach concepts, a Conduct hypersonic flight exper	am. Initiate v nic boundary as well as exp riments to exp	work to deve layer transit pendable an plore aerome	elop, demons ion and aero id reusable h echanics, pro	trate and value odynamic hea oppersonic ai opulsion, ma	lidate measu ating for curr r-breathing o terials/struct	rement/ ent/future concepts. ures,					
and controls research issues th transition, shock boundary layer <i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						ii y iayei					
transition, shock boundary layer		combustor fl	lame holding		ut, etc).		40.551	76.526	53.588	0.000	53.58
transition, shock boundary layer FY 2011 OCO Plans: In FY 2011 OCO: N/A C. Other Program Funding Summa Line Item	r interaction, o ary (\$ in Milli FY 2009	ions)	lame holding Accomplish <u>FY 2011</u> <u>Base</u>	ments/Plann <u>FY 2011</u> <u>OCO</u>	ed Program <u>FY 2011</u> <u>Total</u>	s Subtotals	FY 2013	FY 2014	FY 2015	<u>Cost To</u> Complete	Total Co
transition, shock boundary layer FY 2011 OCO Plans: In FY 2011 OCO: N/A C. Other Program Funding Summa	r interaction, o ary (\$ in Milli	combustor fl	lame holding Accomplishi <u>FY 2011</u>	n, lean blowo ments/Plann <u>FY 2011</u>	ed Program <u>FY 2011</u>	s Subtotals			<u> </u>	<u>Cost To</u>	<u> </u>

Force performance goals and most importantly, how they contribute to our mission.

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Exhibit R-2, RDT&E Budget Item J	Justification	: PB 2011 A	ir Force						DATE: February 2010			
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develo	t & Evaluatio			<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsion and Power Technology								
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
Total Program Element	175.292	192.241	136.135	0.000	136.135	112.786	115.313	120.264	129.044	Continuing	Continuing	
6310SP: Space Rocket Prop Demo	22.724	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
632480: Aerospace Fuels	14.998	26.524	9.393	0.000	9.393	6.882	6.731	7.668	7.965	Continuing	Continuing	
633035: Aerospace Power Technology	11.450	14.936	5.556	0.000	5.556	5.842	5.766	8.522	10.224	Continuing	Continuing	
634921: Aircraft Propulsion Subsystems Int	44.678	39.592	41.403	0.000	41.403	18.006	18.176	17.867	19.479	Continuing	Continuing	
634922: Space & Missile Rocket Propulsion	4.736	29.515	31.840	0.000	31.840	28.059	31.925	39.865	41.610	Continuing	Continuing	
635098: Advanced Aerospace Propulsion	28.301	23.832	13.177	0.000	13.177	20.457	17.959	18.617	20.357	Continuing	Continuing	
63681B: Advanced Turbine Engine Gas Generator	48.405	57.842	34.766	0.000	34.766	33.540	34.756	27.725	29.409	Continuing	Continuing	

## <u>Note</u>

Note: In FY 2010, work in PE 0603216F Project 10SP was consolidated into PE 0603216F Project 4922 within this program element to better align work.

## 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

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Fo	orce			DATE:	February 2010	1
APPROPRIATION/BUDGET ACTIVITY	R-1 ľ	TEM NOMENCLA	TURE			
3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	PE 0	603216F: <i>Aerosp</i> a	ace Propulsion and Pow	ver Technology		
propulsion projects within this program are part of the Versatile projects supports adaptive cycle technology demonstrations wh performance, fuel efficiency, and durability for widely varying mi technology readiness level appropriate for in-flight demonstration Missile Rocket Propulsion project develops and demonstrates in projects within this program are part of the Integrated High Payo Sustainment of Strategic Systems.	ich develop co ission needs. In and for full i nnovative rock	omponent technol The Advanced Ae ntegration with ot et propulsion tecl	logy for an adaptive cycle prospace Propulsion pro her engine cycles (inclu hnologies, propellants, r	e engine architecture ject develops the scra ding turbine and rocke nanufacturing techniqu	that provides o mjet propulsior et based). The s ues. Rocket pro	ptimized cycle to a Space and opulsion
B. Program Change Summary (\$ in Millions)						
	FY 2009	<u>FY 2010</u>	FY 2011 Base	FY 2011 OCO	<u>FY 2011</u>	Total
Previous President's Budget	180.554	175.676	0.000	0.000		0.000
Current President's Budget	175.292	192.241	136.135	0.000	-	6.135
Total Adjustments	-5.262	16.565	136.135	0.000	13	6.135
<ul> <li>Congressional General Reductions</li> </ul>		-6.055				
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000				
Congressional Rescissions	0.000	-0.800				
Congressional Adds		23.420				
Congressional Directed Transfers	0.000	0.000				
Reprogrammings     SBIR/STTR Transfer	0.000 0.000	0.000 0.000				
Other Adjustments	-5.262	0.000	136.135	0.000	13	6.135
Congressional Add Details (\$ in Millions, and Includes	General Rec	luctions)			FY 2009	FY 2010
Project: 6310SP: Space Rocket Prop Demo						
Congressional Add: Hybrid Sounding Rocket Propulsi	ion.				0.798	0.00
		Cong	ressional Add Subtotals	for Project: 6310SP	0.798	0.00
Project: 632480: Aerospace Fuels				-		
Congressional Add: Assured Aerospace Fuels Resea	rch.				1.596	0.00
<b>5 . . . . . . . . . .</b>					1	

ibit R-2, RDT&E Budget Item Justification: PB 2011 Air Forc	e [	DATE: February 2010	
ROPRIATION/BUDGET ACTIVITY D: Research, Development, Test & Evaluation, Air Force B: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>		
Congressional Add Details (\$ in Millions, and Includes G	eneral Reductions)	FY 2009	FY 2010
Congressional Add: Renewable Hydrocarbon Fuels for	Military Applications.	1.995	1.9
Congressional Add: Algal Biofuels for Aviation.		0.000	2.3
Congressional Add: Algal-Derived Jet Fuel for Air Force	Applications.	0.000	2.6
Congressional Add: Hawaii Microalgae Biofuel Project.		0.000	3.5
	Congressional Add Subtotals for Project: 63	2480 4.389	14.5
Project: 633035: Aerospace Power Technology			
Congressional Add: Silicon Carbide (SiC) Power Electro	onics for More Electric Aircraft.	3.191	0.0
Congressional Add: <i>Methanol Fuel Cell Development fo</i> (BRITES).	r USAF Battlefield Renewable Integrated Tactical Energy System	0.000	2.3
Congressional Add: Silicon Carbide Power Modules for	the F-35 Joint Strike Fighter.	0.000	2.3
Congressional Add: Texas Research Institute for Enviro	nmental Studies.	0.000	0.7
	Congressional Add Subtotals for Project: 63	3035 3.191	5.5
Project: 634921: Aircraft Propulsion Subsystems Int			
Congressional Add: Small Adaptive Cycle Turbine Engin	nes.	1.596	0.0
Congressional Add: Small Turbofan Versatile Affordable	Advanced Turbine Engine (VAATE) Program.	3.590	3.1
	Congressional Add Subtotals for Project: 63-	4921 5.186	3.1
	Congressional Add Totals for all Pro	jects 13.564	23.3

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force		DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: <i>Aerospace Propulsion and Power Technology</i>	/
JP8 Fuel Development, \$3.52 million for Hawaii Microalgae Bio Integrated Tactical Energy System (BRITES), \$2.0 million for F	Aviation, \$2.7 million for Algal-Derived Jet Fuel for Air Force Ap ofuel Project, \$2.4 million for Methanol Fuel Cell Development for Renewable Hydrocarbon Fuels for Military Applications, \$2.4 mill I Turbofan Versatile Affordable Advanced Turbine Engine Progra	r USAF Battlefield Renewable

C. Performance Metrics (U) Under Development.

Exhibit R-2A, RDT&E Project Jus	tification: Pl	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACT 3600: Research, Development, Tes BA 3: Advanced Technology Devel	r Force Rever Technology PROJECT PROJECT 6310SP: Space Rocket F				Image: NCLATURE     PROJECT       erospace Propulsion and     6310SP: Space Rocket Prop Demo						
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
6310SP: Space Rocket Prop Demo	22.724	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

#### <u>Note</u>

Note: In FY 2010 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 a seven-year increase in satellite on-orbit time, a 50 percent increase in satellite maneuvering capability, a 25 percent reduction in orbit transfer operational costs, and a 15 percent increase in satellite payload. The efforts in this project contribute to the IHPRPT program, a joint Department of Defense, National Aeronautics and Space Administration, and industry effort to focus rocket propulsion technology on national space launch needs.

## B. Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch vehicles.	15.769	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Completed advanced cryogenic upper stage hardware fabrication and begin testing components to validate and verify modeling and simulation tools developed. Developed hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsio Power Technology	n and	PROJECT 6310SP: S	<b>F</b> Space Rocket Prop Demo		
B. Accomplishments/Planned Program (\$ in Millions)	,					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
for future reusable launch vehicles. Continued material manuf hydrocarbon boost demonstration program. Continued advance and proof efforts.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
FY 2011 Base Plans: In FY 2011: Not Applicable.						
FY 2011 OCO Plans: In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop solar electric propulsion technologies vehicles, and satellite formation flying, station keeping, and reposit		0.220	0.000	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Developed electric propulsion systems for orbit-tr thrusters capable of low earth orbit to geosynchronous orbit tr of the high-power hall thruster demonstration. Continued hard mode (high thrust or high efficiency) propulsion system for sat advanced chemical propulsion system for satellites.	ansfer. Conducted and completed testing ware scale-up for an advanced multi-					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
FY 2011 Base Plans: In FY 2011: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsion Power Technology	n and	<b>PROJECT</b> 6310SP: <i>Sp</i>			
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop electric and advanced chemical base for future satellite propulsion systems. Phases are referring to IHP		5.937	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Continued development of advanced IHPRPT Pl technologies.	nase III monopropellant thruster					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
FY 2011 Base Plans: In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
Acco	omplishments/Planned Programs Subtotals	21.926	0.000	0.000	0.000	0.000
		FY 2009	FY 2010			
		0.798	0.000			
Congressional Add: Hybrid Sounding Rocket Propulsion.						
FY 2009 Accomplishments:						

Exhibit R-2A, RDT&E Project Justi	nibit R-2A, RDT&E Project Justification: PB 2011 Air Force								DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develop	& Evaluation			R-1 ITEM NO PE 0603216 Power Techr	F: Aerospac		n and	PROJECT 6310SP: Sp	bace Rocket		
B. Accomplishments/Planned Prog	gram (\$ in N	lillions <u>)</u>		·							
							FY 2009	FY 2010			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
				Congre	ssional Add	s Subtotals	0.798	0.000			
C. Other Program Funding Summa	ary (\$ in Mill	ions)									
	- <b>-</b>		<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					Cost To	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	Base	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cos
• PE Not Provided (3423): Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>D. Acquisition Strategy</b> 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, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)									<b>PROJECT</b> 632480: <i>Aerospace Fuels</i>				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate				Total Cost		
632480: Aerospace Fuels	14.998	26.524	9.393	0.000	9.393	6.882	6.731	7.668	7.965	Continuing	Continuing		

#### <u>Note</u>

Note: The funding in this project has decreases in FY 2011 and beyond due to planned taper of turbine engine technologies.

## A. Mission Description and Budget Item Justification

This project evaluates and demonstrates improved hydrocarbon fuels, unique/alternate fuels and advanced, novel aerospace propulsion technologies for Air Force applications; including high-speed/hypersonic flight and technologies 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 evaluates 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Demonstrate thermally stable fuels and fuel system hardware concepts to enhance cooling capacity (performance), minimize fuel coking, and reduce fuel system maintenance.	1.869	3.000	2.866	0.000	2.866
<i>FY 2009 Accomplishments:</i> In FY 2009: Demonstrated engine and airframe durability and performance benefits from the use of alternative fuels. Developed knowledge base needed for Air Force-wide certification of alternative fuels, especially biofuels. Demonstrated cooling air systems and other advanced aircraft thermal management systems. 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. Developed key					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsion Power Technology	PE 0603216F: Aerospace Propulsion and				
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
thermal management technologies, including high heat sink fu temperature/thermally efficient fuel pumps.	uels, cooled cooling air systems, and high					
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Demonstrate adaptive engine cycles for high efficiency technologies integrated power/thermal management systems as well as approaches to deoxygenate fuel to improve thermatical FY 2011 Base Plans:</li> <li>In FY 2011: Demonstrate adaptive engine cycles for high efficiency technologies integrated power/thermal management systems as well as approaches to deoxygenate fuel to improve thermatical power/thermal management systems as well as approaches to deoxygenate fuel to improve thermatical power/thermal management systems as well as approaches to deoxygenate fuel to improve thermatical power/thermal management systems as well as approaches to deoxygenate fuel to improve thermatical power/thermal management systems as well as approaches to deoxygenate fuel to improve thermatical power/thermatical power/th</li></ul>	that include cooled cooling air systems, al stability. ciency and ultra efficient turbine engine that include cooled cooling air systems,					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Determine fuel cooling requirements and special and directed energy weapons that will meet the needs of evolving		2.200	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Demonstrated an advanced UAV/ultra efficient tu management system that includes a cooled cooling air system for ensuring fuel flow in wing tanks under high altitude, long en 2010, efforts in this and the next major thrust were combined organizational structure.	n, as well as advanced approaches ndurance conditions. Note: In FY					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsio Power Technology	on and	<b>PROJECT</b> 632480: <i>Ae</i>	els		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Not Applicable. FY 2011 OCO Plans:						
In FY 2011 OCO: N/A. MAJOR THRUST: Develop and demonstrate efficacy of low-cost, reduce soot particulate emissions from gas turbine engines. <i>FY 2009 Accomplishments:</i>	environmentally friendly fuel additives to	0.934	1.500	1.196	0.000	1.196
In FY 2009 Accomposition and solution of fuel/com full-scale engine testing. Continued demonstration of fuel/com and NOx.						
FY 2010 Plans: In FY 2010: Assess fuel structure/combustion performance re Demonstrate advanced particulate measurement diagnostics Assess effectiveness of chemical kinetic models for jet fuels to data.	suitable for full-scale engine testing.					
FY 2011 Base Plans: In FY 2011: Assess fuel structure/combustion performance re Assess effectiveness of chemical kinetic models for jet fuels to data.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate enhancements to fu	el system technology.	0.934	1.500	1.043	0.000	1.043

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	uary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsion a Power Technology	and	<b>PROJECT</b> 632480: <i>Aerospace Fuels</i>				
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2009 Accomplishments: In FY 2009: Developed combined cycle engine cooling system fuels and other advanced fuels.	ns, utilizing 2nd-generation endothermic						
FY 2010 Plans: In FY 2010: Demonstrate extended duration operation of com systems with 2nd generation endothermic fuels. Evaluate sup endothermic fuels.							
FY 2011 Base Plans: In FY 2011: Demonstrate effective supersonic combustion of a	2nd-generation endothermic fuels.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Identify, develop, and demonstrate low-cost ap footprint for the Expeditionary Air Force.	proaches to reducing the fuel logistics	0.934	1.019	1.097	0.000	1.09	
FY 2009 Accomplishments: In FY 2009: Developed ability to model spread of biological m Initiated demonstration of advanced additives to mitigate biological alternative aerospace fuels.							
FY 2010 Plans: In FY 2010: Model spread of biological materials (fungus, bac systems. Demonstrate advanced additives for mitigation of bio							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsion Power Technology	<b>PROJECT</b> 632480: <i>Ae</i>	<b>ECT</b> 0: <i>Aerospace Fuels</i>				
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 Base Plans: In FY 2011: Model spread of biological materials (fungus, bac systems. Demonstrate advanced additives for mitigation of bio							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Assured Fuels Initiative: Characterize and dem hydrocarbon jet fuel to comply with Air Force certifications and sta		3.738	4.946	3.191	0.000	3.19 <sup>-</sup>	
FY 2009 Accomplishments: In FY 2009: Determined fuel structure changes required to in Determined elastomer swell agents capable of increasing swe determination of new specification requirements for biomass-	ell to typical JP-8 levels. Began						
FY 2010 Plans: In FY 2010: Investigate biomass-derived fuel and specificatio swell agents for 100 percent synthetic paraffinic kerosene fue footprint assessment for alternative aviation fuels. Note: Fund emphasis on development of alternative hydrocarbon jet fuel.	ls. Initiate study of greenhouse gas						
FY 2011 Base Plans: In FY 2011: Evaluate biomass-derived fuel and specification from varying feedstocks. Study greenhouse gas footprint asse							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
Acco	omplishments/Planned Programs Subtotals	10.609	11.965	9.393	0.000	9.393	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			[	DATE: February 201
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsio Power Technology	n and	<b>PROJECT</b> 632480: <i>Aerc</i>	ospace Fuels
3. Accomplishments/Planned Program (\$ in Millions)			I	
		FY 2009	FY 2010	
Congressional Add: Assured Aerospace Fuels Research.		1.596	0.000	
FY 2009 Accomplishments: In FY 2009: Created sufficient alternative (non-petroleum) jet properties studies. The facility is also used for collaborative stu- technology to produce suitable jet fuels for AF use.				
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Bio-JP8 Fuel Development.		0.798	3.983	
FY 2009 Accomplishments: In FY 2009: Evaluated an alternative biofuel production pathw initial "biokerosene" jet fuels to be evaluated.	ay with hydrotreated fats and oils as the			
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally directed effort in Bio-JP	8 Fuel Development.			
Congressional Add: Renewable Hydrocarbon Fuels for Military Ap	plications.	1.995	1.992	
FY 2009 Accomplishments: In FY 2009: Conducted research to identify the most promisin applications.	g types of algae for use in military			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propuls Power Technology	sion and	<b>PROJECT</b> 632480: <i>Ae</i>	erospace Fuels
B. Accomplishments/Planned Program (\$ in Millions)	I		1	
		FY 2009	FY 2010	]
FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort in Renew: Applications.	able Hydrocarbon Fuels for Military			
Congressional Add: Algal Biofuels for Aviation.		0.000	2.390	-
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally directed effort in Algal B	iofuels for Aviation.			
Congressional Add: Algal-Derived Jet Fuel for Air Force Applicatior	ns	0.000	2.689	
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort in Algal-D applications.	Perived Jet Fuel for Air Force			
Congressional Add: Hawaii Microalgae Biofuel Project.		0.000	3.505	
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort in the Hay	waii Microalgae Biofuel Proiect.			

Exhibit R-2A, RDT&E Project Jus	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									ruary 2010	
						<b>PROJECT</b> 632480: <i>Ae</i>	rospace Fue	els			
<b>B. Accomplishments/Planned Pro</b>	ogram (\$ in M	lillions)									
							FY 2009	FY 2010			
				Congre	ssional Add	s Subtotals	4.389	14.559			
C. Other Program Funding Summ	nary (\$ in Mill	ions <u>)</u>	FY 2011	FY 2011	FY 2011				,	Cost To	
Line Item	FY 2009	FY 2010	Base	000	Total	FY 2012	FY 2013	FY 2014	FY 2015		Total Cost
• PE 0602203F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Propulsion.											
• PE 0602102F: Materials.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602204F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sensors.											
• PE 0603112F: Advanced Materials for Weapons Systems.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

## **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, RDT&E Project Just	1					DATE: February 2010					
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develo	& Evaluatio					wer Technology					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
633035: Aerospace Power Technology	11.450	14.936	5.556	0.000	5.556	5.842	5.766	8.522	10.224	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop electrical power and thermal management component subsystem technologies for integration with directed energy weapons (DEW) to deliver high power for DEW operation.	0.396	0.207	0.250	0.000	0.250
FY 2009 Accomplishments: In FY 2009: Completed analysis of high power megawatt class generator test results.					
FY 2010 Plans: In FY 2010: Initiate development of high energy laser flight demonstration power and thermal management systems.					
FY 2011 Base Plans: In FY 2011: Initiate development of energy storage, power conditioning, and thermal management subsystems to support flight demonstration of a high energy laser.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsio Power Technology	n and	<b>PROJECT</b> 633035: <i>Ae</i>	erospace Power Technology			
B. Accomplishments/Planned Program (\$ in Millions)			·				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop power generation/conditioning/distributermal management components and subsystem technologies for		3.191	3.992	1.939	0.000	1.939	
FY 2009 Accomplishments: In FY 2009: Designed high temperature demonstrator and fat	pricated key components.						
FY 2010 Plans: In FY 2010: Complete detailed design of high temperature, er fabrication of power and thermal management components.	nergy optimized demonstrator and initiate						
FY 2011 Base Plans: In FY 2011: Integrate, fabricate, and modify high temperature management components. Note: In FY 2011, decrease in fun technologies to PE 0602203F, Aerospace Propulsion, to bette level of this effort.	ding in is due to the movement of						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop power and thermal management com fielded and future high power aircraft to enable efficient power acq		4.672	4.814	2.883	0.000	2.883	
FY 2009 Accomplishments: In FY 2009: Investigated, designed, and developed efficient, I range, rugged/robust power electronics, motor controls, actua management components and subsystems.							

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsion Power Technology	n and	<b>РROJECT</b> 633035: Ае	T Aerospace Power Technology		
B. Accomplishments/Planned Program (\$ in Millions)	·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans: In FY 2010: Fabricate rugged/robust power electronics, motor co actuators, and adaptive power and thermal management subsyste modifications to support integrated subsystems testing.</li> <li>FY 2011 Base Plans: In FY 2011: Integrate subsystems (including rugged/robust power performance electric actuators, and adaptive power and thermal r perform integrated system level evaluation testing. Perform syste demonstrate that integrated subsystems meet design criteria and 2011, the efforts in this thrust are reduced due to higher AF priorit</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A.</li> </ul>	ems. Develop subsystems er electronics, motor controls, high management technologies) and em modifications as necessary to performance objectives. Note: In FY					
<ul> <li>MAJOR THRUST: Develop hybrid electrical power and thermal mana technologies for special purpose applications, enabling long endurance <i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.</li> <li><i>FY 2010 Plans:</i> In FY 2010: Investigate optimization of advanced hybrid fuel cell/achieve minimum volume/weight, maximum power/energy density ruggedness, efficiency, and reliability. Assess hybrid energy man special purpose applications to address needed strike, intelligenc capabilities. Integrate hybridized energy electrical power, and the with end-user operational subsystems such as sensors and comma continuation of the fuel cell and battery work previously applied</li> </ul>	be small unmanned aerial systems. battery subsystem designs to y, and increased battery/fuel cell hagement systems for expanded te, surveillance, and reconnaissance ermal management components nunication devices. Note: This is	0.000	0.346	0.484	0.000	0.484

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsion Power Technology	n and	<b>PROJECT</b> 633035: Aerospace Power Technolog			ogy
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009. In FY 2010, efforts were broken out the clearly show unmanned aerial systems (UAS).	w application of these technologies to					
FY 2011 Base Plans: In FY 2011: Develop and fabricate energy optimized, lightwei thermal management subsystems for increased endurance U applications.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
Acco	omplishments/Planned Programs Subtotals	8.259	9.359	5.556	0.000	5.55
		FY 2009	FY 2010			
Congressional Add: Silicon Carbide (SiC) Power Electronics for M	lore Electric Aircraft.	3.191	0.000			
FY 2009 Accomplishments: In FY 2009: Developed reliable, high voltage (600-1200V), hi mode vertical junction field effect transistors and Schottky dio evaluation and enhancement, applications engineering, and re	des, manufacturing yield limiter					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
		0.000	2.390			

<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsion Power Technology	n and	<b>PROJECT</b> 633035: <i>Ae</i>	erospace Power Technology
B. Accomplishments/Planned Program (\$ in Millions)				
		FY 2009	FY 2010	
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally directed effort in Methar Battlefield Integrated Tactical Energy System (BRITES).	nol Fuel Cell Development for USAF			
Congressional Add: Silicon Carbide Power Modules for the F-35 Jo	pint Strike Fighter.	0.000	2.390	
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally directed effort in Silicon Joint Strike Fighter.	Carbide Power Modules for the F-35			
Congressional Add: Texas Research Institute for Environmental St	udies.	0.000	0.797	
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally directed effort at the Tex Environmental Studies.	xas Research Institute for			
	Congressional Adds Subtotals	3.191	5.577	1

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: February 2010			
3600: Research, Development, Test	APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				DMENCLAT F: Aerospac nology	<b>URE</b> e Propulsior	n and	<b>PROJECT</b> 633035: <i>Ae</i>	rospace Pov	ver Technolo	ogy	
C. Other Program Funding Summa	ary (\$ in Mill	ions)										
			FY 2011	FY 2011	FY 2011					Cost To		
Line Item	FY 2009	<u>FY 2010</u>	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	Complete	<b>Total Cost</b>	
• PE 0602201F: Aerospace Flight	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Dynamics.												
• PE 0602203F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Propulsion.												
• PE 0602605F: Directed Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Technology.												
• PE 0603605F: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Weapons Technology.												

#### **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, RDT&E Project Jus	stification: PE	3 2011 Air F	orce						DATE: February 2010			
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 3: Advanced Technology Devel	st & Evaluatio	,					<b>PROJECT</b> 634921: <i>Air</i>	craft Propuls	sion Subsyst	tems Int		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
634921: Aircraft Propulsion Subsystems Int	44.678	39.592	41.403	0.000	41.403	18.006	18.176	17.867	19.479	Continuing	Continuing	

#### 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 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Design, fabricate, and demonstrate durability and integration technologies for turbofan/ turbojet engines to improve durability, supportability, and affordability of AF aircraft.	1.621	2.625	7.267	0.000	7.267

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsio Power Technology	n and	<b>PROJECT</b> 634921: <i>Ai</i>	rcraft Propuls	sion Subsyst	ems Int
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Completed testing and started validation of engine agile combat support technologies. Initiated design of advance mechanical systems, interactions between the inlet and fan, an	d features for durable fans, turbines,					
FY 2010 Plans: In FY 2010: Complete preliminary design and begin detailed d fans, turbines, mechanical systems, interactions between the in To include advanced cooling design for low pressure turbine bl externals, and repair validation.	nlet and fan, and controls/accessories.					
FY 2011 Base Plans: In FY 2011: Complete detailed design and begin fabricate hard fans, turbines, mechanical systems, interactions between the in To include advanced cooling design for low pressure turbine bl externals, and repair validation. Note: In FY 2011, funding is in preliminary design to detailed design of durable turbine engine	nlet and fan, and controls/accessories. ades, health monitoring, light weight creased due to shift in emphasis from					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Design, fabricate, and test advanced componer and fuel consumption of turbofan/turbojet engines.	t technologies for improved performance	30.877	28.786	26.142	0.000	26.142
FY 2009 Accomplishments: In FY 2009: Finished assembly and began testing of engine de engine using variable cycle features, an advanced fan, improve cooled Ceramic Matrix Composites (CMC), advanced augment ducts. Finished detailed design of advanced adaptive cycle (thi	ed turbine using cooled metal and or, and lightweight CMC cases and					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsion Power Technology	and	<b>PROJECT</b> 634921: Aircraft Propulsion Subsystems					
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 201 <sup>°</sup> Total		
including an advanced fan, high work variable low turbine for l and advanced exhaust nozzle for subsonic to sustained super long lead hardware for an advanced fan, high work variable lo inlet integration, and advanced exhaust nozzle for subsonic to conceptual design for a high bypass/high overall pressure ratio	sonic flight. Finished procurement of w turbine for long dwell time, controls, sustained supersonic flight. Initiated							
FY 2010 Plans: In FY 2010: Initiate assembly testing of engine designs for a so variable cycle features, an advanced fan, improved turbine us advanced augmentor, and lightweight CMC cases and ducts. cycle (third air stream) engine technologies, including an advan for long dwell time, controls, inlet integration, and advanced ex supersonic flight. Initiate preliminary design for a high bypass/ improved fuel consumption. Note: In FY 2010 and FY 2011, the higher AF priorities.	ing cooled metal and cooled CMCs, Begin to fabricate advanced adaptive nced fan, high work variable low turbine khaust nozzle for subsonic to sustained high overall pressure ratio engine for							
FY 2011 Base Plans: In FY 2011: Continue fabrication and begin assembly of adva engine technologies, including an advanced fan, high work va controls, inlet integration, and advanced exhaust nozzle for su Continue preliminary design for a high bypass/high overall pre consumption.	riable low turbine for long dwell time, bsonic to sustained supersonic flight.							
FY 2011 OCO Plans: In FY 2011 OCO: N/A.								
MAJOR THRUST: Design, fabricate, and test component technolo the performance, durability, and affordability of missile and unman		6.994	4.994	7.994	0.000	7.9		

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsion Power Technology	n and	<b>PROJECT</b> 634921: <i>Ai</i>	rcraft Propuls	sion Subsyst	ems Int
B. Accomplishments/Planned Program (\$ in Millions)						
				FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Finished testing of advanced components for teo an advanced light weight fan/compressor, turbines with new a bearings and high through flow combustors for high mach mis higher specific thrust, low cost expendable turbine engine for Initiated design of low spool components for fuel efficient sub	advanced cooling approaches, oil-less ssile applications. Initiated design of a improved fuel efficiency improving range.					
FY 2010 Plans: In FY 2010: Conduct preliminary design of a higher specific t engine for improved fuel efficiency improving range. Conduct advanced low spool turbine, and advanced engine componer unmanned turbofan engines. Note: In FY 2010, funding dips o components.	preliminary design of advanced fan, ts for improved fuel efficient subsonic					
FY 2011 Base Plans: In FY 2011: Conduct detailed design of a higher specific thru for improved fuel efficiency improving range. Conduct detailed spool turbine spool, and advanced engine components for fue engines. Note: In FY 2011, funding is increased due to shift in detailed design of expendable turbine engines.	d design of advanced fan, advanced low el efficient subsonic unmanned turbofan					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO:  N/A.						
Acco	omplishments/Planned Programs Subtotals	39.492	36.405	41.403	0.000	41.403
	ſ	FY 2009	FY 2010	]		
		1.596		-		

Exhibit R-2A, RDT&E Project Just	stification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 3: Advanced Technology Deve	st & Evaluatior			<b>R-1 ITEM N</b> PE 0603216 <i>Power Techr</i>	F: Aerospac		n and	PROJECT 634921: Air	craft Propuls	sion Subsyst	ems Int
B. Accomplishments/Planned Pl	ogram (\$ in N	lillions)									
	•						FY 2009	FY 2010			
Congressional Add: Small Adapti	ve Cycle Turbi	ne Engines.									
FY 2009 Accomplishments: In FY 2009: Performed risk ro temperature rear bearing.	eduction for an	advanced c	ooled metal	turbine and f	for an advar	ced high					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
Congressional Add: Small Turbof	an Versatile Af	fordable Adv	anced Turbi	ine Engine (\	VAATE) Pro	gram.	3.590	3.187			
FY 2009 Accomplishments: In FY 2009: Supported the or high pressure compressor, ar					•	nts for					
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congre Advanced Turbine Engine (V/	•		he Small Tu	rbofan Versa	atile Affordat	ble					
				Congre	essional Add	s Subtotals	5.186	3.187			
C. Other Program Funding Sum	narv (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	FY 2009	FY 2010	<b>Base</b>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>		<u>Complete</u>	
• PE 0602201F: Aerospace Flight	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Dynamics. • PE 0602203F: Aerospace Propulsion.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
· · · · · · · · · · · · · · · · · · ·	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
	0.000	0.000	0.000			0.000	0.000	0.000			

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Exhibit R-2A, RDT&E Project	Justification: PB	2011 Air Fo	rce					_	DATE: February 2010					
3600: Research, Development,	APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD) C. Other Program Funding Summary (\$ in Millions)				R-1 ITEM NOMENCLATUREPROJECTPE 0603216F: Aerospace Propulsion and Power Technology634921: Aircl						- ircraft Propulsion Subsystems Int			
C. Other Program Funding Su	mmary (\$ in Mill	ions <u>)</u>												
Line Item	FY 2009	FY 2010	<u>FY 2011</u> Base	<u>FY 2011</u> OCO	<u>FY 2011</u> Total	FY 2012	FY 2013	FY 2014	FY 2015	<u>Cost To</u>	o Total Cost			
PE 0603003A: Aviation Advanced Technology.	<u>F1 2009</u>	<u>F 1 2010</u>	Dase	000	<u>10tai</u>	<u>F 1 2012</u>	<u>F 1 2013</u>	<u>F1 2014</u>	<u>F1 2013</u>	complete				
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, RDT&E Project Just	ification: PE	3 2011 Air F	orce						DATE: February 2010			
· · · · ·	PROPRIATION/BUDGET ACTIVITY       R-1 ITEM NOMENCLATURE       PROJECT         0: Research, Development, Test & Evaluation, Air Force       PE 0603216F: Aerospace Propulsion and Power Technology       634922: Space & Missile Rocket Propulsion         3: Advanced Technology Development (ATD)       Power Technology       Power Technology								opulsion			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
634922: Space & Missile Rocket Propulsion	4.736	29.515	31.840	0.000	31.840	28.059	31.925	39.865	41.610	Continuing	Continuing	

#### <u>Note</u>

Note: In FY 2010, 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 TSSS program and Integrated High Payoff Rocket Propulsion Technology on rational space launch needs.

#### B. Accomplishments/Planned Program (\$ in Millions)

			FY 2011	FY 2011	FY 2011
	FY 2009	FY 2010	Base	000	Total
MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch vehicles.	0.000	19.707	25.608	0.000	25.608

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsio Power Technology	n and	<b>PROJECT</b> 634922: <i>Sp</i>	ace & Missile	e Rocket Pro	opulsion
3. Accomplishments/Planned Program (\$ in Millions)	,		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2009 Accomplishments: In FY 2009: Not Applicable.</li> <li>FY 2010 Plans: In FY 2010: Demonstrate through hot fire testing advanced cr validate and verify modeling and simulation tools developed. C engine components for integration and demonstration in advan future reusable launch vehicles. Initiate sub-scale component</li> </ul>	Continue development of hydrocarbon need hydrocarbon engine concepts for testing to demonstrate hydrocarbon					
<ul> <li>boost technologies. Continue material manufacturing scale-up demonstration program.</li> <li>FY 2011 Base Plans: In FY 2011: Complete the validation and verification of modeli for advanced cryogenic upper stage technologies. Continue de components for integration and demonstration in an advanced future reusable launch vehicles. Continue sub-scale componer boost technologies. Continue material manufacturing scale-up demonstration program. Initiate component demonstration for technologies using fuels other than kerosene that address IHF funding is increased due to initiation of component demonstration technologies. </li> </ul>	ing and simulation tools developed evelopment of hydrocarbon engine hydrocarbon engine concept for nt testing to demonstrate hydrocarbon effort to support hydrocarbon boost advanced hydrocarbon engine PRPT Phase III goals. Note: In FY 2011,					
FY 2011 OCO Plans: In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop solar electric, electric, and monoprope and future satellites, upper stages, orbit transfer vehicles, and sate		0.000	1.051	3.196	0.000	3.19

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsio Power Technology	n and	<b>PROJECT</b> 634922: Space & Missile Rocket Propulsio				
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Continue hardware scale-up for an advanced mu propulsion system for satellites. Complete demonstration of ac satellites.							
FY 2011 Base Plans: In FY 2011: Conduct scale-up of micro propulsion technologie mobility on orbit. Continue hardware scale-up and prepare to o advanced multi-mode (high thrust or high efficiency) propulsio this thrust is combined with the following thrust, and reduced in	conduct testing of hardware for an n system for satellites. Note: In FY 2011,						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop electric and advanced chemical based for future satellite propulsion systems. Phases are referring to IHPI		0.000	5.226	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Complete development and demonstration of IHF technologies for spacecraft. Initiate scale-up of next generation propulsion systems.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsic Power Technology	on and	<b>PROJECT</b> 634922: Space & Missile Rocket Propu			
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Not Applicable. Note: In FY 2011, this thrust is co reduced in order to better align technologies.	ombined with the previous thrust, and					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate missile propulsion a technologies for ballistic missiles.	nd Post Boost Control Systems	3.982	1.896	1.911	0.000	1.91
FY 2009 Accomplishments: In FY 2009: Completed testing of motor demonstrating TSSS	Phase I goals.					
FY 2010 Plans: In FY 2010: Develop advanced missile propulsion technologic developments providing sub-scale validation of modeling and out, efforts are reduced due to higher AF priorities.						
FY 2011 Base Plans: In FY 2011: Continue development of advanced missile prop component developments providing sub-scale validation of m						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate aging and surveillan reduce lifetime prediction uncertainty for individual motors, enablin		0.754	1.635	1.125	0.000	1.12

Exhibit R-2A, RDT&E Project Ju	stification: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 3: Advanced Technology Deve	est & Evaluation	, Air Force		<b>R-1 ITEM N</b> PE 0603216 <i>Power Techi</i>	F: Aerospac	-	n and	<b>PROJECT</b> 634922: <i>Sp</i>	ace & Missil	e Rocket Pr	opulsion
B. Accomplishments/Planned P	rogram (\$ in N	lillions)									
		<i>,</i>					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Conducted full-s rocket motors to validate and											
FY 2010 Plans: In FY 2010: Conduct full-sca motors to validate and verify						olid rocket					
FY 2011 Base Plans: In FY 2011: Continue integra tools for solid rocket motors t technologies.											
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO:  N/A.											
			Accomplish	ments/Plann	ed Program	s Subtotals	4.736	29.515	31.840	0.000	31.840
C. Other Program Funding Sum	mary (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	FY 2009	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	FY 2013	<u>FY 2014</u>	<u>FY 2015</u>		
• PE 0602102F: <i>Materials.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602203F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Propulsion.											
	~ ~ ~ ~ ~	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0602601F: Spacecraft	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.000
<ul> <li>PE 0602601F: Spacecraft Technology.</li> <li>PE 0603401F: Advanced Spacecraft Technology.</li> </ul>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000 0.000

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)								<b>PROJECT</b> 634922: Space & Missile Rocket Propulsion			
C. Other Program Funding Summa	ary (\$ in Mill	ions <u>)</u>									
Line Item • PE 0603500F: <i>Multi-Disciplinary</i> <i>Advanced Development Space</i>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u> <u>Base</u>	<u>FY 2011</u> <u>OCO</u>	<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
Technology. • PE 0603853F: Evolved Expendable Launch Vehicle Program.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603114N: Power Projection Advanced Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

#### 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, RDT&E Project Justification: PB 2011 Air Force										DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				R-1 ITEM N PE 0603210 Power Tech			n and	<b>PROJECT</b> 635098: Advanced Aerospace Propulsion					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost		
635098: Advanced Aerospace Propulsion	28.301	23.832	13.177	0.000	13.177	20.457	17.959	18.617	20.357	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate technologies for a hydrocarbon-fueled scramjet with robust operation over a range of Mach 4 to 8.	28.301	23.832	13.177	0.000	13.17
FY 2009 Accomplishments: In FY 2009: Conducted integrated air vehicle/propulsion flight tests and conducted post test data reduction and reporting.					
FY 2010 Plans: 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.					

Exhibit R-2A, RDT&E Project Ju	ustification: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET AC 3600: Research, Development, To BA 3: Advanced Technology Deve	est & Evaluation	, Air Force		<b>R-1 ITEM N</b> PE 0603216 Power Techr	F: Aerospac	-	<b>PROJECT</b> 635098: Advanced Aerospace Propulsion				
B. Accomplishments/Planned F	Program (\$ in M	lillions)	I					1			
-							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Develop and destart system, fuel system, and due to higher AF priorities.</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2001 OCO: N/A.</li> </ul>		•	•			•					
			Accomplish	ments/Plann	ed Program	s Subtotals	28.301	23.832	13.177	0.000	13.17
C. Other Program Funding Sum <u>Line Item</u> • PE 0602102F: Materials. • PE 0602203F: Aerospace	nmary (\$ in Mill <u>FY 2009</u> 0.000 0.000	<u>ions)</u> <u>FY 2010</u> 0.000 0.000	FY 2011 Base 0.000 0.000	FY 2011 OCO 0.000 0.000	FY 2011 <u>Total</u> 0.000 0.000	<u>FY 2012</u> 0.000 0.000	FY 2013 0.000 0.000	0.000	FY 2015 0.000 0.000	<u>Cost To</u> <u>Complete</u> 0.000 0.000	<u>Total Cos</u> 0.00
Propulsion. D. Acquisition Strategy Not Applicable.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
<b>E. Performance Metrics</b> Please refer to the Performance Force performance goals and m	•				Air Force re	esources are	e applied ar	nd how those	resources a	re contributi	ng to Air

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force										DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)					,	<b>TURE</b> ce Propulsio	n and	<b>PROJECT</b> 63681B: Advanced Turbine Engine Gas Generator					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost		
63681B: Advanced Turbine Engine Gas Generator	48.405	57.842	34.766	0.000	34.766	33.540	34.756	27.725	29.409	Continuing	Continuing		

#### <u>Note</u>

Note: The funding in this project decreases in FY 2011 due to planned taper of turbine engine 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. 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
MAJOR THRUST: Design, fabricate, and demonstrate performance predictions in core engines, using	37.681	46.648	21.410	0.000	21.410	
innovative engine cycles and advanced materials for turbofan/turbojet engines.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603216F: Aerospace Propulsio Power Technology	PE 0603216F: Aerospace Propulsion and 63681E				
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2009 Accomplishments: In FY 2009: Completed assembly and demonstration of advar advanced turbine materials incorporating next generation cooli combustor and turbine heat loads, ceramic turbine component thermal management, and power extraction. Completed fabric: demonstration of unique compression system components. Co temperature capable, durable compressor, combustor, and tur range strike core engine. Conducted conceptual design and in technologies for a core-centric durability engine demonstration component technologies for increased reliability, maintainabilit to fielded systems. Conducted analysis and conceptual design weapon systems integration on core engine performance.</li> <li>FY 2010 Plans: In FY 2010: Complete detailed design and initiate hardware fa durable compressor, combustor, and turbine for sustained sup Complete preliminary design and initiate detailed design of cor reliability, maintainability, and affordability for potential transitio and conceptual design of system-level technologies and weap performance. Note: Funding increased in FY 2010 to complete engine demonstrations</li> <li>FY 2011 Base Plans: In FY 2011: Continue hardware fabrication and initiate assem durable compressor, combustor, and turbine for sustained sup Complete detailed design and initiate fabrication of component durability engine demonstrations</li> </ul>	and systems for active control, ation, assembly, and experimental ompleted preliminary design of high bine for sustained supersonic long itiated preliminary design of component b. Conducted preliminary design of y, and affordability for potential transition of system-level technologies and abrication of high temperature capable, ersonic long range strike core engine. mponent technologies for a core-centric omponent technologies for increased on to fielded systems. Conduct analysis on systems integration on core engine e hardware fabrication and conduct					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATUREPROJECPE 0603216F: Aerospace Propulsion and Power Technology63681B: Generate			Advanced Turbine Engine Gas			
B. Accomplishments/Planned Program (\$ in Millions)			•				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
reliability, maintainability, and affordability for potential transition to preliminary design and initiate detailed design of system-level tech integration on core engine performance. Note: Fudning reduced in hardware fabrication and engine demonstrations.							
In FY 2011 OCO: N/A. MAJOR THRUST: Design, fabricate, and demonstrate high overall pro- increased durability and affordability with lower fuel consumption for tu		10.724	11.194	13.356	0.000	13.356	
FY 2009 Accomplishments: In FY 2009: Completed fabrication, assembly, and demonstration concept with advanced core technologies including high efficiency temperature capability compressor, high efficiency, high heat rele high cooling effectiveness turbine with an integrated thermal many mechanical systems. Initiated design of higher pressure ratio core design of core for highly efficient core engine concept with an inte and advanced mechanical systems. Completed design, initiated h selective risk reduction experimental demonstrations of UAS sma core engine technologies including a high heat release combustor systems for thermal management, and advanced power extraction efficient small scale propulsion technologies for use in UAS applied	of a highly efficient core engine y, high pressure ratio, high ase combustor, and high work, agement system and advanced components. Conducted preliminary grated thermal management system ardware fabrication, and continued I versatile affordable advanced y, durable high performance turbine, n. Conducted preliminary design of						
FY 2010 Plans: In FY 2010: Complete preliminary design and initiate long lead fa core engine concept with advanced core technologies including h ratio, high temperature capability compressor, high efficiency, high high work, high cooling effectiveness turbine with an integrated th	igh efficiency, high pressure n heat release combustor, and						

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fc	orce						DATE: Febr	ruary 2010	
APPROPRIATION/BUDGET ACTIVI 3600: Research, Development, Test BA 3: Advanced Technology Develop	& Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603216 Power Techr	F: Aerospac	<b>URE</b> e Propulsion	and	<b>PROJECT</b> 63681B: Ad Generator	dvanced Turbine Engine Gas		
B. Accomplishments/Planned Prog	gram (\$ in M	lillions)									
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
advanced mechanical systems. experimental demonstrations of including a high heat release co management and advanced pow fabrication of efficient small eng	UAS small v mbustor, dui wer extractio	versatile affo rable high pe n. Complete	rdable advar erformance to e preliminary	nced core en urbine, and s design and	gine techno systems for i initiate long	logies hermal					
FY 2011 Base Plans: In FY 2011: Conduct detailed de core technologies including high compressor, high efficiency, hig turbine with an integrated therm selective risk reduction experime core engine. Complete detailed technologies including high effic high efficiency, high heat releas turbine for use in UAS application	n efficiency, h h heat releas al managem ental demon design and i iency, high p e combustor	high pressur se combusto ent system strations of l nitiate fabric pressure ratio	e ratio, high t or, and high v and advance JAS small ve ation of effic o, high temp	temperature vork, high co d mechanica ersatile afford ient small en erature capa	capability oling effecti al systems. dable advan gine compo bility compr	veness Continue ced nent essor,					
FY 2011 OCO Plans: In FY 2011 OCO: N/A.											
			Accomplish	ments/Plann	ed Program	s Subtotals	48.405	57.842	34.766	0.000	34.766
C. Other Program Funding Summa	ry (\$ in Mill	ions)									
		-	<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	FY 2009	FY 2010	Base	000	<u>Total</u>	FY 2012	FY 2013	FY 2014		<u>Complete</u>	
• PE 0602201F: Aerospace Flight Dynamics.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602203F: Aerospace Propulsion.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Ju	ustification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 3: Advanced Technology Deve	est & Evaluation	,		R-1 ITEM NO PE 0603216 Power Techr	F: Aerospac		n and	<b>PROJECT</b> 63681B: Ad Generator	vanced Turb	ine Engine	Gas
C. Other Program Funding Sum	nmary (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	Base	<u>000</u>	<u>Total</u>	<u>FY 2012</u>	FY 2013	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost
• PE 0603003A: Aviation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Advanced Technology.											

#### **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, RDT&E Budget Item Justification: PB 2011 Air Force									DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and Personnel Protection Technology							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	35.742	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
632830: Decision Effectiveness Technology	25.064	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
634924: Warfighter Readiness Technology	7.830	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
635020: Bioeffects & Protection Technology	2.848	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### <u>Note</u>

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; 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 5323 and Project 5326 to better align efforts. Funds for the FY 2008 Congressionallydirected 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.

xhibit R-2, RDT&E Budget Item Justification: PB 2011 Air F	orce			DATE:	February 2010	)
<b>PPROPRIATION/BUDGET ACTIVITY</b> 600: Research, Development, Test & Evaluation, Air Force A 3: Advanced Technology Development (ATD)		EM NOMENCLA 03231F: Crew Sy	TURE stems and Personnel Pl	rotection Technology		
. Program Change Summary (\$ in Millions)						
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	<u>FY 2011</u>	
Previous President's Budget	36.411	0.000	0.000	0.000		0.000
Current President's Budget	35.742	0.000	0.000	0.000		0.000
Total Adjustments	-0.669	0.000	0.000	0.000		0.000
<ul> <li>Congressional General Reductions</li> </ul>		0.000				
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000				
<ul> <li>Congressional Rescissions</li> </ul>	0.000	0.000				
<ul> <li>Congressional Adds</li> </ul>		0.000				
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000				
<ul> <li>Reprogrammings</li> </ul>	0.000	0.000				
<ul> <li>SBIR/STTR Transfer</li> </ul>	0.000	0.000				
Other Adjustments	-0.669	0.000	0.000	0.000		0.000
Congressional Add Details (\$ in Millions, and Include	s General Red	uctions)		[	FY 2009	FY 2010
Project: 632830: Decision Effectiveness Technology						
Congressional Add: Air Purification with Carbon Nar	otube Nanostru	ctured Material.			4.986	0.000
Congressional Add: PhasorBIRD Helmet Tracker.					2.473	0.000
		Cong	ressional Add Subtotals	for Project: 632830	7.459	0.000
Project: 634924: Warfighter Readiness Technology				-		
Congressional Add: Joint Theater Air Ground Simula	ation System.				2.393	0.000
		Cong	ressional Add Subtotals	for Project: 634924	2.393	0.000
			Congressional Add To	otals for all Projects	9.852	0.000
Change Summary Explanation C. Performance Metrics						
			Congressional Add To	otals for all Projects	9.852	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010		
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Tes BA 3: Advanced Technology Develo	t & Evaluatio	,	Force R-1 ITEM NOMENCLATURE PROJECT PE 0603231F: Crew Systems and Personnel Protection Technology Protection Effectiveness								
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
632830: Decision Effectiveness Technology	25.064	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### <u>Note</u>

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.

#### 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop/demonstrate human-centered tools for the AF Information Operations (IO) and Intelligence, Surveillance and Reconnaissance (ISR) communities.	2.591	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Designed advanced IO/ISR/Cyber technologies and demonstrated next-generation IO/ISR/Cyber operator workstation capabilities to operationally integrate/normalize AF non-kinetic capabilities with kinetic operations. Developed operator-aiding and training tools for IO/ISR/Cyber					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and Pe Protection Technology	ersonnel	<b>PROJECT</b> 632830: <i>De</i>	ecision Effect	fectiveness Technology		
B. Accomplishments/Planned Program (\$ in Millions)	,						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
operators. Initiated advanced Cyber influence development. N move to PE 0603456F, Project 5324 to better align efforts.	IOTE: In FY 2010, this major thrust will						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop/demonstrate human effectiveness techr reporting, situation assessment, and decision support for Combined	•	1.825	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Integrated visualization tools with other collaborati of operational assessment data into strategy planning data. De unified strategy planning and assessment support tool in a simu major thrust will move to PE 0603456F, Project 5324 to better a	emonstrated a final visually-oriented, ulated CAOC. NOTE: In FY 2010, this						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
FY 2011 Base Plans: In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and P Protection Technology	<b>PROJECT</b> 632830: <i>De</i>	JECT 330: Decision Effectiveness Technology				
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
MAJOR THRUST: Develop/demonstrate technologies to interface betwee machine components through unified visual and auditory displays.	een ground controllers and multiple	3.748	0.000	0.000	0.000	0.000	
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Developed and demonstrated human systems integrated and other battlefield Airmen. Demonstrated technologies for three-in visually obscured environments while improving team situational voice communications. Incorporated a geo-located survival guide in demonstrated its value in an operationally relevant environment. D advanced battlefield air traffic control capability in the combat control intelligent agent technology to improve battlefield Airmen situational wartime scenario. Completed hardware and software implementatis station technology baseline and a next-generation supervisory control demonstration program using real-time system simulation and field phases. Established the scope of simulation and test activities, self-determined key performance measures, and commenced the assess major thrust will move to PE 0603456F, Project 5327 to better align <i>FY 2010 Plans:</i></li> </ul>	dimensional audio navigation awareness by geo-location of nto a wearable computer and eveloped and incorporated an oller's software suite. Incorporated I awareness in a dynamic on of a supervisory control rol station. Planned a technology testing in spiral demonstration ected experimental variables, ssment. NOTE: In FY 2010, this						
In FY 2010: Not Applicable.							
FY 2011 Base Plans: In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop/demonstrate decision-aiding technologies to predict most likely adversary behaviors, and select/prioritize appropriate		2.147	0.000	0.000	0.000	0.000	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and P Protection Technology	PE 0603231F: Crew Systems and Personnel 63283				
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2009 Accomplishments: In FY 2009: Integrated tools developed in first spiral of Comma decision aids into identified technology demonstration program. simulation tools in the technology demonstration environment. spiral development cycle informed by the results of the technolog relief and global war on terrorism emphases. Identified exercise and utility of the decision aid tools and simulation. Planned a technoTE: In FY 2010, this major thrust will move to PE 0603456F</li> <li>FY 2010 Plans: In FY 2010: Not Applicable.</li> <li>FY 2011 Base Plans: In FY 2011: Not Applicable.</li> </ul>	Evaluated the CPE decision aids and Refined tools and began the second gy demonstration with humanitarian to evaluate the expanded benefits echnology demonstration program.					
FY 2011 OCO Plans: In FY 2011 OCO: N/A						
<ul> <li>MAJOR THRUST: Develop/demonstrate bio-taggant and identification needs to enhance force protection/enable air operations commande</li> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Developed the selected bio-taggant technologies a need to include incorporation of quantum dot and mixed-metal models of optimal insertion/distribution of bio-taggants in target thrust will move to PE 0603456F, Project 5326 to better align effective of the selected bio-taggant for the selected bio-taggant for the selected bio-taggant bio-taggants in target thrust will move to PE 0603456F, Project 5326 to better align effective of the selected bio-taggant for the selected bio-taggants in target bio-taggants will move to PE 0603456F, Project 5326 to better align effective of the selected bio-taggants in target and the selected bio-taggants in target bio-taggants will move to PE 0603456F, Project 5326 to better align effective of the selected bio-taggants in target and the selected bio-taggants in target bio-taggants will move to PE 0603456F, Project 5326 to better align effective of the selected bio-taggants in target bio-taggants in target bio-taggants will move to PE 0603456F, Project 5326 to better align effective of the selected bio-taggants in target bio-taggants will move to PE 0603456F, Project 5326 to better align effective of the selected bio-taggants will be the selected bio-taggants bio-taggants will be the selected bio-taggants bio-taggants will be the selected bio-</li></ul>	rs to maintain operations tempo. and refined application to mission nanoparticle technologies. Developed areas. NOTE: In FY 2010, this major	1.497	0.000	0.000	0.000	0.000
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and Protection Technology	Personnel	<b>PROJECT</b> 632830: Decision Effectiveness Technolo				
B. Accomplishments/Planned Program (\$ in Millions)	· · · ·		1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 Base Plans: In FY 2011: Not Applicable.							
FY 2011 OCO Plans: In FY 2011 OCO: N/A							
MAJOR THRUST: Develop/demonstrate intelligent software agent behavior models, and advanced job performance aiding technolog		1.125	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Developed human behavior modeling of individu situations. Experimented with system-of-systems societal mo scenarios. Demonstrated how information flows through and design reference scenarios to be used as standards for evalu Evaluated promising models and modeling approaches. NOT move to PE 0603456F, Project 5324 to better align efforts.	deling, using increasingly complex is modified by a society. Developed ating different modeling approaches.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop/demonstrate logistics technologies for improved system supportability.	improved deployment operations and	0.863	0.000	0.000	0.000	0.000	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and F Protection Technology	PE 0603231F: Crew Systems and Personnel 632830:				hnology
B. Accomplishments/Planned Program (\$ in Millions)	·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Developed organizational-level change template based logistics operations. Validated these change templates control centers, logistics readiness centers) for effective imple technologies. NOTE: In FY 2009, this effort is terminated du	s in operational settings (e.g., airlift ementation of advanced automation					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop/demonstrate cognitive-based analytic software tools for C2 operations to synchronize personnel in distri		1.865	0.000	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Refined the methods and techniques to decrease time of providing work-centered support services for global C2 simulation of global C2 operations that geographically distribu- situation understanding of the C2 battlespace. NOTE: In FY 0603456F, Project 5327 to better align efforts.	2 operations. Demonstrated in a uted personnel can develop a shared					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and P Protection Technology	Personnel	<b>PROJECT</b> 632830: <i>De</i>	iveness Teci	hnology	
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Not Applicable. FY 2011 OCO Plans:						
In FY 2011 OCO: N/A						
<ul> <li>MAJOR THRUST: Develop/demonstrate technologies for improved performance in known toxic environments and identification of diffice</li> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Developed biomarker-based detection technologic human biosample input in the field. Developed new concepts are operable by non-medical personnel for demonstration of the These technologies will identify potentially threatening toxic expersonnel. Developed predictive human models for threat detection technologies. NOTE: In FY 2010, this major thrust with better align efforts.</li> </ul>	es. Developed methods for collecting for lightweight monitoring devices that e analysis and detection techniques. posures to warfighters to protect AF ection and exposure. Developed te heterogeneous sensor data of	1.944	0.000	0.000	0.000	0.000
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
Acco	nplishments/Planned Programs Subtotals	17.605	0.000	0.000	0.000	0.000

	ification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test 3A 3: Advanced Technology Develo	& Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603231 Protection Te	F: Crew Sys	-	ersonnel	<b>PROJECT</b> 632830: <i>De</i>	<b>F</b> Decision Effectiveness Technolo		
3. Accomplishments/Planned Pro	ogram (\$ in M	<u>illions)</u>	1					I			
						ſ	FY 2009	FY 2010			
Congressional Add: Air Purification	with Carbon	Nanatuha N	apostructure	d Matorial			4.986	0.000			
FY 2009 Accomplishments: In FY 2009: Conducted Congre Nanostructured Material. FY 2010 Plans: In FY 2010: Not Applicable.					arbon Nanot	ube					
Congressional Add: PhasorBIRD H	lelmet Tracke	r.					2.473	0.000			
FY 2009 Accomplishments: In FY 2009: Conducted Congre	essionally-dire	ected effort f	or PhasorBI	RD Helmet 1	Fracker.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
				Congre	ssional Add	s Subtotals	7.459	0.000			
C. Other Program Funding Summa	ary (\$ in Milli	ions)								<b>•</b> • <b>•</b>	
Line Item	FY 2009	FY 2010	FY 2011	<u>FY 2011</u> OCO	<u>FY 2011</u> Total	FY 2012	FY 2013	FY 2014	EV 2015	Cost To Complete	Total Car
• PE 0602202F: <i>Human</i>	0.000	0.000	<u>Base</u> 0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Effectiveness Applied Research. • PE 0603456F: Human	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Effectiveness Adv Tech Dev.			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00

## R-1 Line Item #20

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force       DATE: February 2010											
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and Personnel Protection Technology				<b>PROJECT</b> 632830: Decision Effectiveness Technology			
C. Other Program Funding Summary (\$ in Millions)											
Line Item • PE 0604706F: Life Support Systems.	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u> <u>Base</u>	<u>FY 2011</u> <u>OCO</u>	<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
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, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and Personnel Protection Technology				<b>PROJECT</b> 634924: <i>Warfighter Readiness Technology</i>			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
634924: Warfighter Readiness Technology	7.830	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Advance aerospace/organizational behavior models for integrated warfighter training and rehearsal. Adds realism operations, C2, force protection, and air base defense warfighters.	2.426	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Demonstrated adaptive training within Distributed Mission Operations (DMO) using embedded knowledge and skills assessment. Developed common tools for mission planning, briefing, and after action review that function across air combat, ground operations, and combat operations and planning in an Air and Space Operations Center (AOC). Completed integration and evaluation of joint close air support (JCAS) environment for schoolhouse training. Demonstrated and validated technology alternatives for in-garrison and field deployable JCAS training and rehearsal system.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and F Protection Technology	<b>PROJECT</b> 634924: Warfighter Readiness Technology				
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Initiated development of specifications for integrating forward of and command simulation with JCAS schoolhouse training. De performance assessment in a deployed combat training enviro deployed DMO capability in large scale Live, Virtual, and Cons quantitative methods for certifying simulation fidelity and readi	emonstrated embedded training and onment. Demonstrated integrated structive (LVC) event. Demonstrated					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop low-cost, deployable visual simulation performance capable of supporting imaging of high-resolution fast-		1.074	0.000	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Developed combat immersive visual environment head display/image generation proof of concept component de analyses and technology performance evaluations of the conc	emonstrations. Began human factors					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Febr	uary 2010					
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and F Protection Technology	PE 0603231F: Crew Systems and Personnel			<b>PROJECT</b> 634924: <i>Warfighter Readiness Technology</i>				
B. Accomplishments/Planned Program (\$ in Millions)									
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total			
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A									
MAJOR THRUST: Develop/demonstrate a high-fidelity DMO trainin in an AOC.	g and rehearsal capability for operators	1.937	0.000	0.000	0.000	0.000			
FY 2009 Accomplishments: In FY 2009: Developed integrated strategy and plans division training requirements and optimum mission rehearsal strategies for fielded and emerging systems and applications. Developed event specifications for mission qualification training and contin environment approaches through exercise simulations, data ca of experience, spectrum of training capability, and performance live EW range integration into DMO. Developed a simulation of sensor suite for DMO. Developed a proof-of-concept desktop simulations with a synthetic threat environment featuring advan directed energy threats. Began measuring and validating impr technologies and techniques. Began the development of meth- training capability on airborne aircraft and design systems and during a live-fly exercise at an EW training range.	s. Developed integration methods I team, inter-team, and division-level nuation training scenarios. Validated opture, and analysis to define quality assessment capabilities. Completed of an advanced platform-specific EW system integrating multiple EW suite need missile fly out models and basic ovements in EW training using these ods for improved, embedded EW								
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.									
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.									
FY 2011 OCO Plans: In FY 2011 OCO: N/A									

	oit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010					
APPROPRIATION/BUDGET ACTIN 3600: Research, Development, Tes BA 3: Advanced Technology Develo	at & Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603231 Protection Te	F: Crew Sys		ersonnel	<b>PROJECT</b> 634924: <i>Wa</i>	r Varfighter Readiness Technology						
B. Accomplishments/Planned Pro	ogram (\$ in M	illions)													
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total				
			Accomplish	ments/Plann	ed Program	s Subtotals	5.437	0.000	0.000	0.000	0.000				
							FY 2009	FY 2010							
						2.393	0.000								
Congressional Add: Joint Theater	Air Ground Sir	nulation Sys	stem.												
<ul> <li>FY 2009 Accomplishments: In FY 2009: Conducted Congr System.</li> <li>FY 2010 Plans: In FY 2010: Not Applicable.</li> </ul>	ressionally-dire	ected effort f	or Joint The	ater Air Grou	ind Simulatio	on									
				Congre	ssional Add	s Subtotals	2.393	0.000							
C. Other Program Funding Summ	nary (\$ in Milli	ons)													
			<u>FY 2011</u>	<u>FY 2011</u>	FY 2011					Cost To					
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	000	Total	<u>FY 2012</u>	FY 2013	<u>FY 2014</u>		<u>Complete</u>	Total Cost				
• PE 0602202F: <i>Human</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
• PE 0602202F: <i>Human</i> <i>Effectiveness Applied Research.</i>											0.000				
<ul> <li>PE 0602202F: Human</li> <li>Effectiveness Applied Research.</li> <li>PE 0603456F: Human</li> </ul>	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000				
<ul> <li>PE 0602202F: Human</li> <li>Effectiveness Applied Research.</li> <li>PE 0603456F: Human</li> <li>Effectiveness Adv Tech Dev.</li> </ul>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
<ul> <li>PE 0602202F: Human</li> <li>Effectiveness Applied Research.</li> <li>PE 0603456F: Human</li> </ul>											0.000 0.000 0.000				
<ul> <li>PE 0602202F: Human</li> <li>Effectiveness Applied Research.</li> <li>PE 0603456F: Human</li> <li>Effectiveness Adv Tech Dev.</li> <li>PE 0604227F: Distributed</li> </ul>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000 0.000				

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force	DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and Personnel Protection Technology	<b>PROJECT</b> 634924: <i>W</i> a	arfighter Readiness Technology

#### **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, RDT&E Project Justification: PB 2011 Air Force										DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)								<b>PROJECT</b> 635020: <i>Bioeffects &amp; Protection Technology</i>				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
635020: Bioeffects & Protection Technology	2.848	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing	

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate technologies that permit safe testing, deployment, and use of high energy laser weapons and systems.	1.093	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Completed validation, verification, and accreditation package for laser range safety tool. Released collateral hazard assessment software tool to enable analysis of tactical uses for high- energy laser systems. NOTE: In FY 2010, this major thrust will move to PE 0603456F, Project 5323 to better align efforts.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and F Protection Technology	Personnel	<b>PROJECT</b> 635020: <i>Bioeffects &amp; Protection Technol</i>			hnology
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop and demonstrate technologies to asse frequency (RF) systems, including terahertz technologies.	ess bioeffects and protection from radio	1.420	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Developed laser and RF and other non-ionizing p protection. Developed bioeffects-based fire-control algorithms Integrated laser protective technologies with those for RF, mid electromagnetic radiation for personnel protection. Established directed energy protective equipment. Conducted long-term s NOTE: In FY 2010, this major thrust will move to PE 0603456	s for directed energy weapons. crowave, terahertz, and other regimes of ed preliminary design specifications for studies of RF weapon systems effects.					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
		0.335	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Just	tification: PB	2011 Air Fc	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develo	t & Evaluation	, Air Force		<b>R-1 ITEM NOMENCLATURE</b> PE 0603231F: Crew Systems and Personnel Protection Technology					peffects & Pr	otection Tec	hnology
B. Accomplishments/Planned Pro	ogram (\$ in M	illions)	1								
	•	,					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and de enable man-portable threat neutrali			ort testing of	counterforce	e technologie	es and to					
FY 2009 Accomplishments: In FY 2009: Developed technol evidence for special application contaminating aircraft or other 0603456F, Project 5326 to bet	ns. Improved equipment. N	technologie IOTE: In FY	s to enable s	afe return a	nd avoid						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
FY 2011 Base Plans: In FY 2011: Not Applicable.											
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A											
			Accomplish	ments/Plann	ed Program	s Subtotals	2.848	0.000	0.000	0.000	0.000
C. Other Program Funding Summ	arv (\$ in Milli	ions)									
			FY 2011	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	FY 2010	Base	000	Total	FY 2012	FY 2013	FY 2014	FY 2015		Total Cost
• PE 0602102F: <i>Materials.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602202F: Human	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Effectiveness Applied Research.											
• PE 0603112F: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Materials for Weapon Systems. • PE 0603319F: Airborne Laser	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Program.	5.000	0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Exhibit R-2A, RDT&E Project Jus	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force											
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)									OJECT 5020: Bioeffects & Protection Technology			
C. Other Program Funding Summ												
			FY 2011	<u>FY 2011</u>	<u>FY 2011</u>					Cost To		
Line Item	FY 2009	<u>FY 2010</u>	<u>Base</u>	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<b>Complete</b>	Total Cost	
• PE 0603456F: <i>Human</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Effectiveness Adv Tech Dev.												
• PE 0604706F: <i>Life Support Systems.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

#### **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, RDT&E Budget Item					DATE: Feb	ruary 2010					
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Technology</i>							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	29.364	32.056	16.992	0.000	16.992	22.636	23.719	24.367	24.018	Continuing	Continuing
632432: Defensive System Fusion Technology	11.622	4.543	4.707	0.000	4.707	6.292	6.358	6.142	5.926	Continuing	Continuing
63431G: RF Warning & Countermeasures Tech	9.609	21.250	4.142	0.000	4.142	5.502	6.854	7.190	7.028	Continuing	Continuing
63691X: EO/IR Warning & Countermeasures Tech	8.133	6.263	8.143	0.000	8.143	10.842	10.507	11.035	11.064	Continuing	Continuing

#### 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 electronic combat suites. The third project develops and demonstrates advanced warning and countermeasure technologies to defeat electro-optical, infrared, 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.

ibit R-2, RDT&E Budget Item Justification: PB 2011 Air F	orce			DATE:	February 2010	
PROPRIATION/BUDGET ACTIVITY			-			
0: Research, Development, Test & Evaluation, Air Force	PE 06	03270F: Electror	nic Combat Technology			
3: Advanced Technology Development (ATD)						
Program Change Summary (\$ in Millions)						
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011	Total
Previous President's Budget	30.241	31.021	0.000	0.000		0.000
Current President's Budget	29.364	32.056	16.992	0.000	1	6.992
Total Adjustments	-0.877	1.035	16.992	0.000	1	6.992
<ul> <li>Congressional General Reductions</li> </ul>		-0.031				
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000				
<ul> <li>Congressional Rescissions</li> </ul>	0.000	-0.134				
<ul> <li>Congressional Adds</li> </ul>		1.200				
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000				
<ul> <li>Reprogrammings</li> </ul>	0.000	0.000				
SBIR/STTR Transfer	0.000	0.000				
Other Adjustments	-0.877	0.000	16.992	0.000	1	6.992
Congressional Add Details (\$ in Millions, and Include	s General Redu	uctions)		_	FY 2009	FY 2010
Project: 632432: Defensive System Fusion Technology				_		
Congressional Add: Advanced Threat Alert Advance	d Technology De	emonstration.			4.867	0.00
Congressional Add: Commercial-Off-the-Shelf (COT	S) Analysis Tool	s for Navigationa	al Warfare.		1.197	0.00
		Cong	ressional Add Subtotals	s for Project: 632432	6.064	0.00
Project: 63431G: RF Warning & Countermeasures Tech				-		
Congressional Add: Advanced Electromagnetic Loca	ation of IEDs Dei	feat System.			1.596	1.19
Congressional Add: New Electronic Warfare Special	ists Through Ad	vanced Researc	h by Students.		1.596	0.00
		Cong	ressional Add Subtotals	for Project: 63431G	3.192	1.19
			Congressional Add 1	Fotals for all Projects	9.256	1.19

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Technology</i>	

#### **Change Summary Explanation**

Note: In FY 2010, Congress added \$1.2 million for Advanced Electromagnetic Location of IEDs Defeat System. The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

C. Performance Metrics

Under Development.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force										DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Technology</i>				<b>PROJECT</b> 632432: Defensive System Fusion Technology				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
632432: Defensive System Fusion Technology	11.622	4.543	4.707	0.000	4.707	6.292	6.358	6.142	5.926	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 include: 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop affordable radio-frequency and electro-optical emitter warning and electronic warfare battle (EW) management technologies, integrating EW and information operations.	5.558	4.543	4.707	0.000	4.707
FY 2009 Accomplishments: In FY 2009: Conducted 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. Developed and demonstrated technical protocols for the integration of electronic warfare, command-and-control warfare, and information operations against an integrated air defense system. Developed and matured key technologies essential for Airborne Electronic Attack risk reduction.					
FY 2010 Plans: 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					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Te</i>	echnology	<b>PROJECT</b> 632432: <i>De</i>	efensive Syst	em Fusion 1	Fechnology
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
support/electronic attack architecture. Continue research into i information operations to defeat an adversary integrated air de	•					
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Initiate a critical experiment to demonstrate synergy information operations (IO) techniques against a representative an effort to develop a virtual EW/IO battlespace environment for experiments, and assessments. Conduct a demonstration of el techniques and algorithms. Continue with the development of a support/electronic attack architecture.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A.</li> </ul>	e integrated air defense system. Initiate or future project demonstrations, ectronic warfare battle management	5.558	4.543	4.707	0.000	4.707
		FY 2009	FY 2010	1		
Congressional Add: Advanced Threat Alert Advanced Technology <i>FY 2009 Accomplishments:</i> In FY 2009: Conducted Congressionally-directed effort for Adv Technology Demonstration. <i>FY 2010 Plans:</i>		4.867	0.000			
In FY 2010: Not Applicable.						
Congressional Add: Commercial-Off-the-Shelf (COTS) Analysis To	ools for Navigational Warfare.	1.197	0.000			

Exhibit R-2A, RDT&E Project Justifi	cation: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVIT 3600: Research, Development, Test & BA 3: Advanced Technology Developr	Evaluation,	Air Force		<b>R-1 ITEM NO</b> PE 0603270			chnology	<b>PROJECT</b> 632432: <i>De</i>	fensive Syst	tem Fusion	Technolog
B. Accomplishments/Planned Prog	ram (\$ in Mi	illions <u>)</u>									
							FY 2009	FY 2010			
In FY 2009: Conducted Congres Warfare. <i>FY 2010 Plans:</i> In FY 2010: Not Applicable.	sionally-dire	ected effort f	or COTS Ar	alysis Tools	for Navigati	onal					
				Congre	ssional Add	s Subtotals	6.064	0.000			
C. Other Program Funding Summar	y (\$ in Millio	ons)									
			<u>FY 2011</u>	FY 2011	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	FY 2009	FY 2010	<u>Base</u>	000	Total	FY 2012	FY 2013	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Co
• PE Not Provided (6105): Activity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00

• PE Not Provided (6105): Activity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Not Provided											
• PE 0602204F: Aerospace	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sensors.											
• PE 0603203F: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aerospace Sensors.											
• PE 0603500F: Multi-disciplinary	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Advanced Space Technology.											

#### 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, RDT&E Project Just	stification: PE	3 2011 Air F	orce						DATE: February 2010			
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 3: Advanced Technology Deve	st & Evaluatio	,		R-1 ITEM NOMENCLATUREPROJECTPE 0603270F: Electronic Combat Technology63431G: RF ITechTech				F Warning & Countermeasures				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
63431G: RF Warning & Countermeasures Tech	9.609	21.250	4.142	0.000	4.142	5.502	6.854	7.190	7.028	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop aerospace platform jamming technologies and techniques to counter advanced radio-frequency threats associated with current and future aerospace weapon systems.	6.417	20.055	4.142	0.000	4.142
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Provided hardware simulation and analysis support to multi-intelligence sensor needs for accurate and timely electronic surveillance information. Developed 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. Developed advanced simulation capabilities to support network enabled jamming of adversary early warning and surveillance networks. Developed and evaluated integrated digital receiver/jammer brassboard architectures that leverage real-time electronic surveillance signal processing to enhance electronic attack effectiveness.</li> </ul>					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Te</i>	echnology	<b>PROJECT</b> 63431G: <i>Ri</i> <i>Tech</i>	F Warning &	Countermea	asures
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans: In FY 2010: Initiate advanced electronic attack jamming algorithms operations to defeat future advanced threats. Continue to research protection and electronic attack technologies to realize more effectidistributed, multi-node electronic support/electronic attack concept. electronic attack techniques in combination with simultaneous inform the increasing adversary air defense systems moves to increased of sensors. Develop and assess advanced technology, concepts, and of advanced signals on radio frequency receiver-processors.</li> <li>FY 2011 Base Plans: In FY 2011: Initiate next-generation electronic attack techniques co a distributed tactical electronic combat receiver development effort. adaptable electronic combat techniques and algorithms. Provide at architecture concepts for transition.</li> </ul>	n the synergy between electronic ve jamming. Demonstrate a Continue research to tailor mation operations to counter digital integration of defense d algorithms to mitigate the effects ncept definition studies. Initiate Demonstrate cognitive and					
FY 2011 OCO Plans: In FY2011 OCO: N/A.						
Accomplis	hments/Planned Programs Subtotals	6.417	20.055	4.142	0.000	4.142
	[	FY 2009	FY 2010	]		
				-		
Congressional Add: Advanced Electromagnetic Location of IEDs Defea <i>FY 2009 Accomplishments:</i> In FY 2009: Conduct Congressionally-directed effort for Advanced Defeat System.	-	1.596	1.195			

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(ATD)	, Air Force I <mark>illions)</mark>		<b>R-1 ITEM NO</b> PE 0603270				PROJECT			
(\$ in M	<u>illions)</u>				, combat re	cnnology	63431G: RI Tech	Warning &	Countermea	asures
						FY 2009	FY 2010			
-direct	ed effort for	Advanced E	electromagne	tic Location	of IEDs					
						1.596	0.000			
ire Spe	ecialists Thro	ough Advand	ced Research	n by Student	S.					
	ected effort f	or New Elec	tronic Warfa	re Specialist	s					
			Congre	ssional Add	s Subtotals	3.192	1.195			
in Milli	ions)									
	<b>/</b>	<u>FY 2011</u>	FY 2011	<u>FY 2011</u>					<u>Cost To</u>	
	<u>FY 2010</u>	<b>Base</b>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>			
.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	are Spe ally-dire ents.	are Specialists Thro ally-directed effort f ents. in Millions) 2009 FY 2010 0.000 0.000 0.000 0.000 0.000 0.000	are Specialists Through Advance ally-directed effort for New Elect ents. in Millions) <u>FY 2010</u> 0.000 <u>FY 2010</u> 0.000 <u>5.000</u> 0.000 0.000 0.000 0.000	are Specialists Through Advanced Research ally-directed effort for New Electronic Warfar ents. Congre in Millions) <u>FY 2010</u> <u>FY 2011</u> <u>FY 2011</u> 0.000 <u>FY 2010</u> <u>Base</u> <u>OCO</u> 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	are Specialists Through Advanced Research by Student         ally-directed effort for New Electronic Warfare Specialist         ents.         Congressional Add         in Millions)         FY 2011 FY 2011 FY 2011 FY 2011         2009 FY 2010 Base OCO Total         0.000       0.000       0.000       0.000         0.000       0.000       0.000       0.000         0.000       0.000       0.000       0.000         0.000       0.000       0.000       0.000         0.000       0.000       0.000       0.000	Congressional Adds Subtotals           in Millions)         FY 2011         FY 2011         FY 2011         FY 2011         FY 2012         OCO         Total         FY 2012         O.000         <	Are Specialists Through Advanced Research by Students.         1.596           ally-directed effort for New Electronic Warfare Specialists ents.         3.192           Congressional Adds Subtotals         3.192           in Millions)         FY 2011         FY 2011         FY 2011         FY 2012         FY 2013           2009         FY 2010         Base         OCO         Total         FY 2012         FY 2013           0.000         0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000         0.000	Are Specialists Through Advanced Research by Students.         1.596         0.000           ally-directed effort for New Electronic Warfare Specialists ents.         3.192         1.195           in Millions)         EY 2011         FY 2011         FY 2011           2009         FY 2010         Base         OCO         Total         FY 2012         FY 2013         FY 2014           0.000         0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000         0.000	Immunol         FY 2011         FY 2012         FY 2013         FY 2014         FY 2015         0.000	Image: Normal and Section 1.596         0.000           are Specialists Through Advanced Research by Students.         1.596         0.000           ally-directed effort for New Electronic Warfare Specialists ents.         1.1596         0.000           Congressional Adds Subtotals         3.192         1.195           in Millions)         FY 2011         FY 2011         FY 2012           2009         FY 2010         Base         OCO         Total           0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000         0.000           0.000         0.000         0.000         0.000         0.000         0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Technology</i>	<b>PROJECT</b> 63431G: <i>Rl</i> <i>Tech</i>	F Warning & Countermeasures

#### 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, RDT&E Project Ju	stification: Pl	3 2011 Air F	orce						DATE: February 2010			
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 3: Advanced Technology Deve	est & Evaluatio	,		R-1 ITEM NOMENCLATURE         PROJECT           PE 0603270F: Electronic Combat Technology         63691X: EO/IR Warni Tech			D/IR Warning	arning & Countermeasures				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
63691X: EO/IR Warning & Countermeasures Tech	8.133	6.263	8.143	0.000	8.143	10.842	10.507	11.035	11.064	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Analyze the vulnerabilities of current infrared missile systems and future imaging infrared sensors.	4.424	1.654	2.987	0.000	2.987
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Performed laboratory analyses on future infrared guided missile capabilities. Assessed effectiveness of current and planned techniques against new threat trends and direction of future countermeasure technique requirements. Conducted digital simulations to assess effectiveness of expendable and laser countermeasure techniques.</li> <li>FY 2010 Plans:</li> <li>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.</li> </ul>					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Te</i>	echnology	PROJECT 63691X: EC Tech	D/IR Warning	& Countern	neasures
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans: In FY 2011: Continue laboratory development and testing of infra and advanced (i.e. imaging) missiles. Evaluate impact of confrom threats on countermeasure design. Continue effort to obtain image major advanced technology demonstrations.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	ting current and next generation					
MAJOR THRUST: Develop aerospace laser warning sensor technologic acquisition/tracking sensors, including detecting and locating both high	• •	0.913	0.593	2.892	0.000	2.892
FY 2009 Accomplishments: In FY 2009: Developed laser warning sensors to address emergin miniaturized laser warning sensors. Fabricated a sensor for sens Demonstrated capability to cue agile filters for optimized protectio	or and eye protection cueing.					
FY 2010 Plans: In FY 2010: Further develop laser warning sensors to address en integration of miniaturized laser warning sensors in sensor protect countermeasures cueing. Develop laser detection/warning/geolog against medium and high energy lasers. Investigate advanced co augmented manpad) detection and geolocation. Demonstrate has sensor engagement testing for mission survivability testing.	tion, personnel protection and cation concepts for air based defense oncepts for laser beam rider (laser					
FY 2011 Base Plans: In FY 2011: Demonstrate advanced concepts for full spectrum las countermeasure hand-off capable of supporting Combat Laser Inf						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat Te</i>	- echnology	PROJECT 63691X: EC Tech	D/IR Warning	& Counterm	neasures
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
System program goals. Demonstrate advanced concepts support and high energy lasers.	oorting airbase defense against medium					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop a countermeasure technology to defea aircraft tracking sensors and ordnance guidance.	at passive electro-optical and infrared	2.649	1.662	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Initiated development of affordable, lightweight in combining passive surveillance and missile defeat techniques compact system to geolocate and identify threats.						
FY 2010 Plans: In FY 2010: Continue development of affordable, lightweight i capability combing passive surveillance and missile defeat teo design of capability to geolocation and identify passive infrare	chniques for tactical aircraft. Continue					
FY 2011 Base Plans: In FY 2011: Not Applicable. Effort eliminated due to higher A	F priorities.					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop electro-optical/infrared missile warning	technologies to alert aircrews and	0.147	0.148	0.000	0.000	0.00

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603270F: <i>Electronic Combat T</i>	echnology	PROJECT 63691X: E Tech	T EO/IR Warning & Countermeasures			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2009 Accomplishments: In FY 2009: Conducted missile warning sub-system integration algorithms for a complete real-time visible missile warning system time environments.							
FY 2010 Plans: In FY 2010: Integrate visible missile warning system into the System.	Affordable Laser Infrared Survivability						
FY 2011 Base Plans: In FY 2011: Not Applicable. Effort eliminated due to higher Af	<sup>-</sup> priorities.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							
MAJOR THRUST: Develop electro-optical sensor component tech mission areas. Develop new sensor components, topologies, and a		0.000	2.206	2.264	0.000	2.26	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Conduct space situational awareness (SSA) sens	or prototype experiments.						
<i>FY 2011 Base Plans:</i> In FY 2011: Continue SSA sensor prototype experiments.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.							

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVI 3600: Research, Development, Test BA 3: Advanced Technology Develop	& Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603270			PROJECT           Technology         63691X: EO/IR Warning & Countermed           Tech         Tech				
<b>B. Accomplishments/Planned Prog</b>	gram (\$ in M	<u>illions)</u>									
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
			Accomplish	nments/Plann	ed Program	s Subtotals	8.133	6.263	8.143	0.000	8.143
C. Other Program Funding Summa	ry (\$ in Mill	ions)	FY 2011	FY 2011	FY 2011					Cost To	
Line Item • PE Not Provided (6503): Activity Not Provided	<u>FY 2009</u> 0.000	<u>FY 2010</u> 0.000	<b>Base</b> 0.000	<b><u>OCO</u></b> 0.000	<u>Total</u> 0.000	<u>FY 2012</u> 0.000	<u>FY 2013</u> 0.000	<u>FY 2014</u> 0.000	<u>FY 2015</u> 0.000	<b>Complete</b> 0.000	<u>Total Cost</u> 0.000
• PE 0602204F: Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0604270F: <i>Electronic</i> <i>Warfare (EW) Development.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<ul> <li>PE 0603500F: Multi-disciplinary Advanced Development Space Technology.</li> <li>PE 0604270N: EW</li> </ul>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

## 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, RDT&E Budget Item	n Justification	: PB 2011 A	ir Force						DATE: February 2010			
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 3: Advanced Technology Deve	est & Evaluatio				IOMENCLA 1F: Advance	TURE ed Spacecraf	t Technology	/				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
Total Program Element	97.834	98.708	83.705	0.000	83.705	75.985	77.194	78.925	78.744	Continuing	Continuing	
632181: Spacecraft Payloads	33.821	33.691	20.548	0.000	20.548	17.853	17.019	18.987	17.712	Continuing	Continuing	
633834: Integrated Space Technology Demonstrations	37.531	28.996	41.188	0.000	41.188	36.082	33.481	32.396	33.148	Continuing	Continuing	
634400: Space Systems Protection	5.892	8.070	5.316	0.000	5.316	6.042	9.711	10.308	10.764	Continuing	Continuing	
635021: Space Systems Survivability	4.123	4.842	3.845	0.000	3.845	3.336	3.367	3.540	3.689	Continuing	Continuing	
635083: Ballistic Missiles Technology	5.195	11.921	5.256	0.000	5.256	5.036	5.039	5.259	6.141	Continuing	Continuing	
63682J: Spacecraft Vehicles	11.272	11.188	7.552	0.000	7.552	7.636	8.577	8.435	7.290	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, RDT&E Budget Item Justification: PB 2011 Air Fo	rce			DATE:	February 2010	)
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)		ITEM NOMENCLA 0603401F: Advance	TURE ed Spacecraft Technolog	gy		
B. Program Change Summary (\$ in Millions)						
	<u>FY 2009</u>	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011	
Previous President's Budget	97.469	83.909	0.000	0.000		0.000
Current President's Budget	97.834 0.365	98.708	83.705	0.000 0.000		3.705 3.705
Total Adjustments <ul> <li>Congressional General Reductions</li> </ul>	0.305	14.799 -0.148	83.705	0.000	o	5.705
Congressional Directed Reductions		0.000				
Congressional Rescissions	0.000	-0.413				
<ul> <li>Congressional Adds</li> </ul>		15.360				
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000				
Reprogrammings	0.000	0.000				
<ul><li>SBIR/STTR Transfer</li><li>Other Adjustments</li></ul>	0.000 0.365	0.000 0.000	83.705	0.000	o	3.705
	0.505	0.000	03.705	0.000	0	5.705
Congressional Add Details (\$ in Millions, and Includes	General Re	ductions)			FY 2009	FY 2010
Project: 632181: Spacecraft Payloads						
Congressional Add: Satellite Coherent Optical Received	er (SCORE).			-	1.745	0.000
Congressional Add: Integrated Spacecraft Engineering	g Tool (ISET)	).		-	1.596	0.000
Congressional Add: Operational Responsive Space A	rchitecture fo	or Dual Use Applica	ations.	-	1.269	0.000
Congressional Add: Semiconductor Optical Amplifier f	or Responsiv	ve Space MPOI.		-	2.194	0.000
Congressional Add: Ultra Low Power Electronics.				-	3.191	0.000
Congressional Add: Micromachined Switches for Next	t-Generation	Modular Satellites.		-	2.394	2.390
Congressional Add: Domestic Manufacturing of 45nm	Electronics.			-	0.000	3.187
Congressional Add: Integrated Passive Electronic Cor	mponents.			-	0.000	1.354
		Cong	ressional Add Subtotals	for Project: 632181	12.389	6.931
Project: 635083: Ballistic Missiles Technology				-		
Fioject. 000000. Dailistic Missiles Technology						

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	C	ATE: February 2010	)
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft Technology</i>		
Congressional Add Details (\$ in Millions, and Includes Gener	al Reductions)	FY 2009	FY 2010
Congressional Add: Ballistic Missile Technology.		0.000	1.593
Congressional Add: Florida National Guard Total Force Integ	ration.	0.000	2.390
Congressional Add: P-Net Ballistic Missile Technology.		0.000	1.992
	Congressional Add Subtotals for Project: 63	5083 0.000	5.975
Project: 63682J: Spacecraft Vehicles			
Congressional Add: Small Low-Cost Reconnaissance Spaced	craft Components/Small Responsive Spacecraft at Low-Cost.	1.596	2.390
Congressional Add: Thin Film Amorphous Solar Arrays.		1.596	0.000
Congressional Add: Space Situational Awareness.		1.197	0.000
	Congressional Add Subtotals for Project: 63	682J 4.389	2.390
	Congressional Add Totals for all Pro	ects 16.778	15.296

#### **Change Summary Explanation**

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

Note: In FY 2010, Congress added \$1.6 million for Ballistic Missile Technology, \$3.2million for Domestic Manufacturing of 45nm Electronics, \$2.4 million for Florida National Guard Total Force Integration, \$1.36 million for Integrated Passive Electronic Components, \$2.4 million for Micromachined Switches for Next Generation Modular Satellites, \$2.4 million for Small Responsive Spacecraft at Low-Cost, and \$2.0 million for P-Net Ballistic Missile Technology.

C. Performance Metrics (U) Under Development.

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force						DATE: February 2010					
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develo	t & Evaluatio			<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft</i> <i>Technology</i>			<b>PROJECT</b> 632181: Spacecraft Payloads				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
632181: Spacecraft Payloads	33.821	33.691	20.548	0.000	20.548	17.853	17.019	18.987	17.712	Continuing	Continuing

#### Note

Note: In FY 2011, some of the technology efforts are being moved from this PE to PE 0602601F, Space Technology, to better reflect the actual technology readiness levels of those efforts.

#### 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, 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop microelectronic devices, including radiation-hardened data processors and high-density hardened memories, advanced packaging technology, and MEMS components and applications.	7.467	8.479	6.431	0.000	6.431
FY 2009 Accomplishments: In FY 2009: Incorporated new Satellite Design Automation software capabilities and demonstrated a logical sequence "push-button toolflow" satellite builder. Integrated high-fidelity radiation-hardened space sensor interface modules using standardized sensor data protocols and demonstrated enhanced device control of sensors and actuators in relevant satellite sub-systems.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>OJECT</b> 2181: Spacecraft Payloads				
B. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
FY 2010 Plans: In FY 2010: Continue demonstrating improved radiation-hardene allocating standardized data messages protocols from sensors for actuators. Continue development of high-density volatile memory development.	r easy device control of sensors and							
FY 2011 Base Plans: In FY 2011: Demonstrate engineering model of high-density vola multiprocessor architecture development. Initiate multiprocessor								
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A								
MAJOR THRUST: Develop intelligent satellite system technologies for satellite control, precision navigation, formation flying, and proximity op		2.214	4.048	3.714	0.000	3.714		
FY 2009 Accomplishments: In FY 2009: Completed development of command, control, guida space superiority. Completed integration of autonomous flight so control, guidance, and navigation technologies. Completed exten testbed, spacecraft command and telemetry simulations, and miss development of modeling command, control, and communications trades, and performed military utility analysis.	ftware technologies with command, ision of hardware-in-the-loop sion operations centers. Explored							
FY 2010 Plans: In FY 2010: Continue to model command, control, and communic trades; and perform military utility analysis for space superiority. I processes to include automated spacecraft design, rapid assemble software configuration, and expedited integration and test.	Initiate rapid spacecraft development							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecraf Technology	PE 0603401F: Advanced Spacecraft 632			PROJECT 632181: Spacecraft Payloads				
B. Accomplishments/Planned Program (\$ in Millions)									
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total			
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Complete model command, control, and communica trades, and perform military utility analysis for space superiority. development processes to include automated spacecraft design, ground software configuration, and expedited integration and test</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: N/A</li> </ul>	Continue rapid spacecraft rapid assembly, automated flight and								
MAJOR THRUST: Develop modeling, simulation, and analysis tools f space capability protection technologies, access/mobility technologies		5.122	6.800	5.231	0.000	5.231			
FY 2009 Accomplishments: In FY 2009: Continued to develop space-based communications awareness, communications on the move, and data exfiltration. A engineering-to-engagement-level models for systems engineering planning, and operations. Extended utility analysis to autonomou flight experiments for space situational awareness, responsive sp technology. Integrated previously developed military utility analysis tools.	Applied additional physics-to- g, technology trades, mission s rendezvous/proximity operations ace, and defensive space control								
FY 2010 Plans: In FY 2010: Continue physics-to-engineering-to-engagement level technology trades, mission planning and operations, and utility an experimental support, and concept of operations of flight program model detection, identification, and characterization technologies and validate military utility and sensor analysis tools for external of analyses for flight programs.	alysis for systems-level analysis, s. Complete integration of tools to for situational awareness. Refine								

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Febr	ruary 2010					
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecrat Technology	PE 0603401F: Advanced Spacecraft 63			<b>PROJECT</b> 632181: <i>Spacecraft Payloads</i>				
B. Accomplishments/Planned Program (\$ in Millions)			1						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total			
FY 2011 Base Plans: In FY 2011: Develop graphic interfaces for simulation and and previous urgent and quick-turn analyses and provide an interfa- responsive flight programs. Transition tools validated in 2009 programs. Apply lessons learned from analytical support, fligh space organizations into refined modeling, simulation, and and flight programs and better model schedule limitations.	ace searchable by various tactical and and 2010 for use in customer flight nt program participation, and external								
FY 2011 OCO Plans: In FY 2011 OCO: N/A									
MAJOR THRUST: Develop space infrared technology and harden acquisition, tracking, and discrimination of hot targets, as well as "o		4.799	5.860	5.172	0.000	5.172			
FY 2009 Accomplishments: In FY 2009: Explored development of full focal plane array for sensor for potential transition.	r exquisite imaging. Developed visible								
FY 2010 Plans: In FY 2010: Continue development of full focal plane array for sensor development. Develop higher operating temperature s sensors.									
FY 2011 Base Plans: In FY 2011: Refine full focal plane array for exquisite imaging operating temperature sensor development. Continue large for									
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A									

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecrat Technology	t	<b>PROJECT</b> 632181: <i>Sp</i>	acecraft Pay	loads	
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop spectral/polarimetric sensing and data imaging and remote sensing applications.	a exploitation demonstrations for military	1.141	1.573	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Compared measurements of satellites to predicti of model based exploitation for space situational awareness.	ve models and determined the feasibility					
<i>FY 2010 Plans:</i> In FY 2010: Initiate studies and analyses of integrated RF/op	tical/polarimetric sensing techniques.					
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop technologies for multi-access laser correduced weight, power, and cost for transformational communication		0.689	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Developed key scientific performance parameter communications needs.	s appropriate for future space					
<i>FY 2010 Plans:</i> In FY 2010: Effort is complete.						
FY 2011 Base Plans: In FY 2011: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecraft Technology	t.	<b>PROJECT</b> 632181: <i>Sp</i>	bacecraft Pay	loads	
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
Acco	omplishments/Planned Programs Subtotals	21.432	26.760	20.548	0.000	20.548
		FY 2009	FY 2010	]		
Congressional Add: Satellite Coherent Optical Receiver (SCORE) FY 2009 Accomplishments:	).	1.745	0.000			
In FY 2009: Conducted Congressionally-directed effort for Sa (SCORE).	atellite Coherent Optical Receiver					
FY 2010 Plans: In FY 2010: Not Applicable.						
Congressional Add: Integrated Spacecraft Engineering Tool (ISE	Т).	1.596	0.000			
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Int (ISET).	tegrated Spacecraft Engineering Tool					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
Congressional Add: Operational Responsive Space Architecture f	for Dual Use Applications.	1.269	0.000			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecraft Technology		<b>PROJECT</b> 632181: <i>S</i>	pacecraft Payloads
B. Accomplishments/Planned Program (\$ in Millions)	,			
		FY 2009	FY 2010	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Op Architecture for Dual Use Applications.	erational Responsive Space			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Semiconductor Optical Amplifier for Responsi	ve Space MPOI	2.194	0.000	)
<i>FY 2009 Accomplishments:</i> In FY 2009: Conducted Congressionally-directed effort for Se Responsive Space MPOI.				
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Ultra Low Power Electronics.		3.191	0.000	)
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Ult	ra Low Power Electronics.			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Micromachined Switches for Next-Generation	Modular Satellites.	2.394	2.390	)

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			1	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecraft Technology		<b>PROJECT</b> 632181: <i>Sp</i>	bacecraft Payloads
B. Accomplishments/Planned Program (\$ in Millions)				
		FY 2009	FY 2010	]
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Mic Generation Modular Satellites.	cromachined Switches for Next-			
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Micro Modular Satellites.	machined Switches for Next-Generation			
		0.000	3.187	-
Congressional Add: Domestic Manufacturing of 45nm Electronics.				
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Dome	estic Manufacturing of 45nm Electronics.			
		0.000	1.354	-
Congressional Add: Integrated Passive Electronic Components.				
FY 2009 Accomplishments: In FY 2009: Not Applicable.				
FY 2010 Plans:	ratad Bassiva Electropia Componenta			
In EV 2010, Conduct Congressionally directed effect for later	ated Passive Electronic Components.			
In FY 2010: Conduct Congressionally-directed effort for Integr				

Exhibit R-2A, RDT&E Project Justif	<b>ication:</b> PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				R-1 ITEM NO PE 0603401 Technology	-	-	<b>PROJECT</b> 632181: <i>Spacecraft Payloads</i>				
C. Other Program Funding Summa	ry (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	Base	<u>000</u>	<u>Total</u>	<u>FY 2012</u>	FY 2013	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cos
• PE 0303601F: MILSTAR Satellite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Communications System.											
• PE 0305160F: <i>Defense</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Meteorological Satellite Program											
(DMSP).											
• PE 0602601F: Space	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Technology.											
• PE 0603215C: Limited Defense	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
System.											
• PE 0603218C: Research and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Support.	0.000	0.000	0.000	0.000	0.000	0.000	0 000	0.000	0.000	0.000	0.00
• PE 0603226E: <i>Experimental</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Evaluation of Major Innovative											
Technologies.	0.000	0.000	0 000	0.000	0.000	0.000	0 000	0.000	0.000	0.000	0.00
• PE 0604609F: Reliability	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
and Maintainability Technology											
Insertion Program (RAMTIP).											

#### 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, RDT&E Project Just	tification: PE	3 2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE       PROJECT         PE 0603401F: Advanced Spacecraft       633834: Integrated Space Technology         Technology       Demonstrations				gу		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
633834: Integrated Space Technology Demonstrations	37.531	28.996	41.188	0.000	41.188	36.082	33.481	32.396	33.148	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 a relevant environment.

#### B. Accomplishments/Planned Program (\$ in Millions)

	EV 2040	FY 2011	FY 2011	FY 2011
				<b>Total</b> 41,188
57.551	20.990	41.100	0.000	41.100
	FY 2009 37.531			

Exhibit R-2A, RDT&E Project Ju	stification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITYR-1 ITEM NOMENCLAT3600: Research, Development, Test & Evaluation, Air ForcePE 0603401F: AdvancedBA 3: Advanced Technology Development (ATD)Technology						aft PROJECT 633834: Integrated Space Technology Demonstrations				gy	
B. Accomplishments/Planned P	rogram (\$ in M	lillions)									
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 OCO Plans: In FY 2011 OCO: N/A											
			Accomplish	ments/Plann	ed Program	s Subtotals	37.531	28.996	41.188	0.000	41.18
C. Other Program Funding Sum	mary (\$ in Mill	ions)									
	51/ 0000	<b>E</b> V 0040	<u>FY 2011</u>	<u>FY 2011</u>	FY 2011					Cost To	
Line Item • PE 0602601F: Space Technology.	<u>FY 2009</u> 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	<u>0C0</u> 0.000	<u>Total</u> 0.000	<u>FY 2012</u> 0.000	<u>FY 2013</u> 0.000	<u>FY 2014</u> 0.000	<u>FY 2015</u> 0.000	<u>Complete</u> 0.000	<u>Total Cos</u> 0.000
• PE 0603605F: Advanced Weapons Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00

#### 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, RDT&E Project Just	t <b>ification:</b> PE	3 2011 Air F	orce						DATE: Feb	ruary 2010				
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develo	t & Evaluatio							PROJECT 634400: Space Systems Protection						
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost			
634400: Space Systems Protection	5.892	8.070	5.316	0.000	5.316	6.042	9.711	10.308	10.764	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: 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.	1.415	2.186	2.325	0.000	2.325
FY 2009 Accomplishments: In FY 2009: Conducted demonstrations illustrating effects and meditation analysis. Identified technology transition opportunities and reported findings to major commands.					
<i>FY 2010 Plans:</i> In FY 2010: Demonstrate additional subsystem performance in laboratory. Identify additional transition opportunities and prepare engineering models to assess performance.					
FY 2011 Base Plans: In FY 2011: Conduct extensive engineering analysis and down select final systems. Perform subsystem testing of RF and laser countermeasures.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecraf Technology	t	<b>PROJECT</b> 634400: <i>Sp</i>	<b>T</b> Space Systems Protection		
B. Accomplishments/Planned Program (\$ in Millions)	· · ·		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop passive satellite countermeasures and future threats to satellites.	mitigation techniques for current and	3.122	2.074	1.297	0.000	1.297
FY 2009 Accomplishments: In FY 2009: Conducted mitigation technology space demonstr	ation and post flight analysis.					
FY 2010 Plans: In FY 2010: Demonstrate enhanced subsystems performance transition opportunities and prepare engineering models to ass						
FY 2011 Base Plans: In FY 2011: Develop performance goals using engineering mo demonstration unit for passive satellite countermeasures.	odels. Begin design of flight					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop visible and near-infrared laser protection is moving to PE 0602601F in order to better align the technology re		1.355	2.026	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Developed selected "space qualified" technology satellite for integration.	and provided test unit to experimental					
FY 2010 Plans: In FY 2010: Build candidate systems and conduct space quali- opportunities and prepare engineering models of performance.	· ·					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecraft Technology	t	<b>PROJECT</b> 634400: Space Systems Protection				
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop active satellite local space awareness satellite systems.	technologies and exploitation tools for	0.000	1.784	1.217	0.000	1.217	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Conduct in-depth study of current capabilities and operators. Demonstrate active subsystems through laboratory performance models.							
FY 2011 Base Plans: In FY 2011: Develop performance goals using engineering mo demonstration unit for potential space situational awareness ap							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop RF characterization methods and performance thrust will be initiated due to increased interest in space superiority		0.000	0.000	0.477	0.000	0.477	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							

Exhibit R-2A, RDT&E Project Justif	fication: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVI</b> 3600: <i>Research, Development, Test of</i> BA 3: <i>Advanced Technology Develop</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecraft Technology			t .	<b>PROJECT</b> 634400: <i>Sp</i>	ace System	s Protection			
B. Accomplishments/Planned Prog	ram (\$ in N	lillions)									
	•	-					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Identify technology RF spectrum. Develop and com superiority technologies. Demon</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: N/A</li> </ul>	plete engine	eering desig	ns for system ugh laborato	ns used to sury testing.	upport active	space	5.892	8.070	5.316	0.000	5.316
			Accomplish	ments/Plann	ed Program	s Subtotais	5.892	8.070	5.310	0.000	5.310
C. Other Program Funding Summa	•		<u>FY 2011</u>	FY 2011	FY 2011	EV 0040			EV 0045	Cost To	Table
Line Item • PE 0602102F: Materials.	<u>FY 2009</u> 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	<u>OCO</u> 0.000	<u>Total</u> 0.000	FY 2012 0.000	FY 2013 0.000	FY 2014 0.000	FY 2015 0.000	Complete 0.000	<u>10tal Cos</u>
• PE 0602601F: SpaceTechnology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603605F: Advanced Weapons Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>D. Acquisition Strategy</b> 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, RDT&E Project Jus	tification: Pl	3 2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTI 3600: Research, Development, Tes BA 3: Advanced Technology Devel					PROJECT 635021: Space Systems Survivability			ty			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
635021: Space Systems Survivability	4.123	4.842	3.845	0.000	3.845	3.336	3.367	3.540	3.689	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop technologies to provide improved space radiation and ionospheric hazard specification and forecasting.	3.149	3.916	3.845	0.000	3.84
FY 2009 Accomplishments: In FY 2009: Completed development of miniaturized space weather sensor engineering models. Identified space test opportunity for miniaturized solar hazard sensors. Initiated development of a new standard model of the radiation belts. Co-operatively operated existing first generation heliospheric imagers in coordinated joint-agency campaign exploiting unique three vantage point configuration. Developed and evaluated concepts for second-generation joint-agency heliospheric imager(s).					
<i>FY 2010 Plans:</i> 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.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecraft Technology	!	<b>PROJECT</b> 635021: <i>Sp</i>	ace System	s Survivabilit	У
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Complete initial version of new standard model of miniaturized space weather sensors. Complete design and b heliospheric imager as joint agency initiative.</li> <li>FY 2011 OCO Plans:</li> </ul>						
In FY 2011 OCO: N/A						
MAJOR THRUST: Develop technology to warn of spacecraft radia and to provide space environment situational awareness and anor		0.974	0.926	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Constructed hardware for space demonstration of sensor. Performed verification and validation of compact environment. Began development of new more	ironment anomaly sensor for diagnosing					
FY 2010 Plans: FY 2010: Develop engineering model of micrometeoroid impa spacecraft anomaly resolution system. Initiate development of sensors, and common satellite interface architecture for space	of radiation dosimeter, spacecraft charge					
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: These efforts are moving to PE 0602601F, align the technology readiness of these efforts.	Space Technology, in order to better					
Acco	mplishments/Planned Programs Subtotals	4.123	4.842	3.845	0.000	3.845

Exhibit R-2A, RDT&E Project J	ustification: PB	2011 Air Fo	rce					_	DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET AC 3600: Research, Development, 7 BA 3: Advanced Technology Dev					<b>PROJECT</b> 635021: Spa	1: Space Systems Survivability <u>Cost To</u>					
C. Other Program Funding Sun	nmary (\$ in Mill	ons)									
	EX 0000		FY 2011	<u>FY 2011</u>	FY 2011	51/ 00/0		E)/ 00//			
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	Base	000	<u>Total</u>	FY 2012	FY 2013	<u>FY 2014</u>			
• PE 0602601F: Space Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>D. Acquisition Strategy</b> 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, RDT&E Project J	ustification: Pl	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET AC 3600: Research, Development, 7 BA 3: Advanced Technology Dev	est & Evaluatio					TURE ed Spacecrat	t	<b>PROJECT</b> 635083: <i>Ba</i>	llistic Missile	es Technolog	<i>IY</i>
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
635083: Ballistic Missiles Technology	5.195	11.921	5.256	0.000	5.256	5.036	5.039	5.259	6.141	Continuing	Continuin
precision instrumentation for ne B. Accomplishments/Planned I	C C	-							FY 2011	FY 2011	FY 2011
MAJOR THRUST: Develop, inte emerging vehicle designs and ot						oplied to	<b>FY 2009</b> 2.598	<b>FY 2010</b> 2.973	<b>Base</b> 2.628	<b>0C0</b>	<b>Total</b> 2.62
FY 2009 Accomplishments:	· ·			•		cornorate					
In FY 2009: Continued eng performance improvements demonstration flight units. I vehicle designs.	Conducted flig	ght qualificat	•	nd evaluatio	n of candida	ite					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecraf Technology	t	<b>PROJECT</b> 635083: <i>Ba</i>	<b>r</b> Ballistic Missiles Technology		
B. Accomplishments/Planned Program (\$ in Millions)	·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Continue advanced navigation instrument engineering test. Continue advanced guidance risk reduction through ground planning. Initiate build and test of flight capable advanced guida integrated with strategic vehicle designs and interfaces.	testing, sled testing, and flight test					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop, integrate, and demonstrate navigation to provide robust, flexible, lower cost solutions for sustaining current	•	2.597	2.973	2.628	0.000	2.628
FY 2009 Accomplishments: In FY 2009: Measured and evaluated performance of advanced safety devices from experimental test bed and sled testing. Con long-lead hardware acquisition for flight testing advanced naviga safety devices with new vehicle design interfaces. Initiated quali validated system level interfaces.	tinued long-term planning and initiated tional instrumentation and range					
FY 2010 Plans: In FY 2010: Complete hardware procurement and initiate the bui instrumentation and range safety devices with new vehicle desig testing of designs against validated system level interfaces. Beg analysis and testing of common advanced navigation instrument system development.	n interfaces. Continue qualification jin dynamic and hostile environments					
FY 2011 Base Plans: In FY 2011: Complete qualification testing of designs against va Complete build and continue test and evaluation of advanced na						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecraft Technology		<b>PROJECT</b> 635083: <i>Ba</i>	allistic Missile	s Technolog	У
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
safety devices with new vehicle design interfaces. Continue dy analysis and testing of common guidance designs. Initiate inter technologies with common vehicle designs and interfaces focu increased accuracy, flexibility, and robustness.	gration of advanced guidance					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
Accor	nplishments/Planned Programs Subtotals	5.195	5.946	5.256	0.000	5.25
		FY 2009	FY 2010	7		
		0.000	1.593	-		
Congressional Add: Ballistic Missile Technology.						
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Ballist	ic Missile Technology.					
Congressional Add: Florida National Guard Total Force Integration		0.000	2.390			
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Florida	a National Guard Total Force					

Exhibit R-2A, RDT&E Project Just	ification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develo	& Evaluation	<b>URE</b> d Spacecraft		s Technolog	y						
<b>B. Accomplishments/Planned Pro</b>	gram (\$ in M	illions)									
							FY 2009	FY 2010			
							0.000	1.992			
Congressional Add: P-Net Ballistic	Missile Tech	nology.									
FY 2009 Accomplishments: In FY 2009: Not Applicable.											
FY 2010 Plans: In FY 2010: Conduct Congress	sionally-direct	ed effort for	P-Net Ballis	stic Missile Te	echnology.						
				Congre	ssional Add	s Subtotals	0.000	5.975			
C. Other Program Funding Summ	2 .	,	<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					Cost To	
Line Item	FY 2009	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	FY 2013	<u>FY 2014</u>		<u>Complete</u>	
• PE 0601102F: Defense	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Research Sciences.	0.000	0.000	0 000	0.000	0.000	0.000	0 000	0.000	0.000	0.000	0 000
• PE 0602601F: Space Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603601F: Conventional	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Weapons Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603851F: Intercontinental	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ballistic Missile-Dem/Val.											
• PE 0604851F: Intercontinental	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ballistic Missile-EMD.											
• PE 0605860F: Rocket System Launch Program-Space.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D. Acquisition Strategy Not Applicable.											

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force	_	DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: <i>Advanced Spacecraft</i> <i>Technology</i>	<b>PROJECT</b> 635083: <i>Ba</i>	allistic Missiles Technology

### 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, RDT&E Project Justification: PB 2011 Air Force										DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITYR-1 ITEM NOMENCLATURE3600: Research, Development, Test & Evaluation, Air ForcePE 0603401F: Advanced SpacecraftBA 3: Advanced Technology Development (ATD)Technology					t	<b>PROJECT</b> 63682J: <i>Sp</i>	acecraft Veł	nicles				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
63682J: Spacecraft Vehicles	11.272	11.188	7.552	0.000	7.552	7.636	8.577	8.435	7.290	Continuing	Continuing	

#### <u>Note</u>

Note: In FY 2011: Changes in funding are due to some technology development efforts being moved to PE 0602601F, Space Technology, in order to better align the technology readiness levels of these efforts.

#### 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop power generation space technologies such as multi-junction solar cells, thin-film solar cells, lightweight solar cell arrays, and radiation resistant solar cell modules.	1.905	2.621	1.978	0.000	1.978
FY 2009 Accomplishments: In FY 2009: Demonstrated greater than 14% efficient thin-film solar cells. Explored performance optimization of greater than 40% efficient solar cell concepts.					
FY 2010 Plans: 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.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecrat Technology	ft	<b>PROJECT</b> 63682J: <i>Sp</i>	CT Spacecraft Vehicles		
B. Accomplishments/Planned Program (\$ in Millions)			I			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Demonstrate module technology traceable to great arrays.	ater than 300 watts/kilograms (W/kg)					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop technologies for long-life, efficient, low cryocoolers and integration components for space applications.	-vibration, lightweight mechanical	0.815	0.830	0.706	0.000	0.70
FY 2009 Accomplishments: In FY 2009: Developed a non-moving parts compressor using Developed a low-vibration conductance, cross gimbal 35 Kelvi space tracking missions. Developed an improved thermal inte transfer capacity in space cooling applications. Further develo interface requirements and improved technologies to support s	n (K) cooling loop interface to support rface material doubling conductive oped technology of satellite cryogenic					
FY 2010 Plans: In FY 2010: Continue support of missile launch detection there study to determine the viability of infrared sensors as an asset development of a non-moving parts compressor using proton I development of a low-vibration conductance, cross gimbal 35k space tracking missions. Continue development of an improve conductive transfer capacity in space cooling applications. Co satellite cryogenic interface requirements and improved techno applications.	for SSA missions. Continue biased membrane technology. Continue Cooling loop interface to support ed thermal interface material doubling ntinue technology development of					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecraft Technology	t	<b>PROJECT</b> 63682J: <i>Sp</i>	bacecraft Veh	icles	
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Continue support of missile launch detection ther Continue development of a non-moving parts compressor usir Continue development of a low-vibration conductance, cross of support space tracking missions. Continue development of ar doubling conductive transfer capacity in space cooling applica of satellite cryogenic interface requirements and improved tec applications.	ng proton biased membrane technology. gimbal 35K cooling loop interface to n improved thermal interface material tions. Continue technology development					
FY 2011 OCO Plans: In FY 2011 OCO: N/A MAJOR THRUST: Develop composites for launch vehicle and spa	acecraft structures and space	2.557	2.788	2.350	0.000	2.35
applications, such as launch vehicle shrouds, thermal protection st <i>FY 2009 Accomplishments:</i> In FY 2009: Flew elastically-deployed, stored strain energy, d including shape memory alloy reinforced hinges. Developed a hardware.	eployable structural architectures					
FY 2010 Plans: In FY 2010: Demonstrate symbiotic structural technologies fo laboratory testing or sub-orbital launch demonstration. Contin testbed for space structures developed for responsive space of low-cost demonstration launch vehicle platforms. Initiate deve to build tailored spacecraft panels in days rather than weeks.	ue development of thermal management class satellites. Continue development of					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecrat Technology	PE 0603401F: Advanced Spacecraft 63				
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Demonstrate novel deployable structural architect structures in relevant sub-system environment. Continue deve to build tailored spacecraft panels in days, rather than weeks, fabricated engineering model panels.	elopment of rapid fabrication processes					
FY 2011 OCO Plans: In FY 2011 OCO: N/A						
MAJOR THRUST: Develop technologies for spacecraft structural applications.	controls and mechanisms for on-orbit	1.606	2.559	2.518	0.000	2.518
FY 2009 Accomplishments: In FY 2009: Implemented advanced estimation algorithms for onto flight hardware prototype under development.	improved local situational awareness					
FY 2010 Plans: In FY 2010: Finish development and integration of advanced situational awareness. Begin development of guidance, navig integration and test.						
FY 2011 Base Plans: In FY 2011: Continue development of advanced guidance, na control moment gyroscopes or reaction wheels for rapid integr of hardware systems while maintaining rapid integration capat testbed for verifying performance of guidance, navigation, and	ation and test. Increase performance pility. Begin development of hardware					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603401F: Advanced Spacecraft Technology		PROJECT 63682J: Sp	PROJECT 63682J: Spacecraft Vehicles				
B. Accomplishments/Planned Program (\$ in Millions)	· · · · ·		1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
Acco	omplishments/Planned Programs Subtotals	6.883	8.798	7.552	0.000	7.55		
		FY 2009	FY 2010	7				
Congressional Add: Small Low-Cost Reconnaissance Spacecraft Spacecraft at Low-Cost.	Components/Small Responsive	1.596	2.390					
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Sr Spacecraft Components.	nall Low-Cost Reconnaissance							
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally-directed effort for Sma	ll Responsive Spacecraft at Low-Cost.							
Congressional Add: Thin Film Amorphous Solar Arrays.		1.596	0.000					
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Th	in Film Amorphous Solar Arrays.							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.								
Congressional Add: Space Situational Awareness.		1.197	0.000					
FY 2009 Accomplishments:								

Exhibit R-2A, RDT&E Project Justi	ification: PB	2011 Air Fo	rce						DATE: Feb	uary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test 3A 3: Advanced Technology Develop	& Evaluation	, Air Force		R-1 ITEM NO PE 0603401 Technology		icles					
3. Accomplishments/Planned Prog	gram (\$ in M	<u>illions)</u>							_		
							FY 2009	FY 2010			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
				Congre	ssional Add	s Subtotals	4.389	2.390			
C. Other Program Funding Summa Line Item • PE 0602203F: Aerospace	<mark>ary (\$ in Milli</mark> <u>FY 2009</u> 0.000	ions) <u>FY 2010</u> 0.000	<u>FY 2011</u> <u>Base</u> 0.000	<u>FY 2011</u> <u>OCO</u> 0.000	<u>FY 2011</u> <u>Total</u> 0.000	<u>FY 2012</u> 0.000	<u>FY 2013</u> 0.000	<u>FY 2014</u> 0.000	<u>FY 2015</u> 0.000	Cost To Complete 0.000	<u>Total Cost</u> 0.000
Propulsion. • PE 0602601F: Space Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603218C: <i>Research and</i> Support.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603226E: Experimental Evaluation of Major Innovative Technologies.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D. Acquisition Strategy Not Applicable.											

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, RDT&E Budget Item J	Iustification	: PB 2011 A	ir Force						DATE: February 2010			
						R-1 ITEM NOMENCLATURE PE 0603444F: MAUI SPACE SURVEILLANCE SYSTEM						
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
Total Program Element	36.093	36.661	5.899	0.000	5.899	5.563	5.522	5.613	5.702	Continuing	Continuing	
634868: <i>Maui Space Surveillance</i> System	36.093	36.661	5.899	0.000	5.899	5.563	5.522	5.613	5.702	Continuing	Continuing	

#### A. Mission Description and Budget Item Justification

This program funds space situational awareness (SSA) 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 2009	<u>FY 2010</u>	<u>FY 2011 Base</u>	<u>FY 2011 OCO</u>	<u>FY 2011</u>	Total
36.339	5.813	0.000	0.000		0.000
36.093	36.661	5.899	0.000		5.899
-0.246	30.848	5.899	0.000		5.899
	0.000				
	0.000				
0.000	-0.152				
	31.000				
	0.000				
0.000	0.000				
0.000	0.000				
-0.246	0.000	5.899	0.000		5.899
es General Redu	<u>uctions)</u>			FY 2009	FY 2010
nd Rapid Respol	nse System (Par	n-STARRS).		7.978	9.461
ing System for S	oace Situational	Awareness and Ballistic	Missile Defense.	1.596	1.992
	36.339 36.093 -0.246 0.000 0.000 -0.246 es General Redu	36.339       5.813         36.093       36.661         -0.246       30.848         0.000       0.000         0.000       -0.152         31.000       0.000         0.000       0.000         0.000       0.000         0.000       0.000         0.000       0.000         0.000       0.000         0.000       0.000         0.000       0.000         0.000       0.000         0.000       0.000         0.000       0.000         es General Reductions)	36.339       5.813       0.000         36.093       36.661       5.899         -0.246       30.848       5.899         0.000       0.000       0.000         0.000       -0.152       31.000         0.000       0.000       0.000         0.000       0.000       0.000         0.000       0.000       5.899         0.000       0.000       5.899         es General Reductions)       5.899	36.339       5.813       0.000       0.000         36.093       36.661       5.899       0.000         -0.246       30.848       5.899       0.000         0.000       0.000       0.000       0.000         0.000       -0.152       31.000       0.000         0.000       0.000       0.000       0.000         0.000       0.000       0.000       0.000         0.000       0.000       5.899       0.000	36.339       5.813       0.000       0.000         36.093       36.661       5.899       0.000         -0.246       30.848       5.899       0.000         0.000       0.000       0.000       0.000         0.000       -0.152       31.000       0.000         0.000       0.000       0.000       0.000         0.000       0.000       0.000       0.000         0.000       0.000       5.899       0.000         0.000       0.000       5.899       0.000         0.000       0.000       5.899       0.000         0.000       0.000       5.899       0.000         es General Reductions)       FY 2009

bit R-2, RDT&E Budget Item Justification: PB 2011 Air Ford	ce [	DATE: February 2	010
ROPRIATION/BUDGET ACTIVITY : Research, Development, Test & Evaluation, Air Force : Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603444F: <i>MAUI SPACE SURVEILLANCE SYSTEM</i>		
Congressional Add Details (\$ in Millions, and Includes (	General Reductions)	FY 2009	FY 2010
	Congressional Add Subtotals for Project: 63	4868 9.57	74 11.4
	Congressional Add Totals for all Pro	jects 9.5	74 11.4
is not provided because it cannot be made in a relevant ma	Hyper-Dimensional Imaging for Near Space Surveillance and Ballisti		

Exhibit R-2A, RDT&E Project Just	tification: PE	3 2011 Air Fo	orce						DATE: Feb	ruary 2010	
· · · ·	PRIATION/BUDGET ACTIVITYR-1 ITEM NOMENCLATUREsearch, Development, Test & Evaluation, Air ForcePE 0603444F: MAUI SPACE SURVEILLANCEvanced Technology Development (ATD)SYSTEM						PROJECT634868: Maui Space Surveillance System				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
634868: <i>Maui Space Surveillance</i> <i>System</i>	36.093	36.661	5.899	0.000	5.899	5.563	5.522	5.613	5.702	Continuing	Continuing

### A. Mission Description and Budget Item Justification

This program funds space situational awareness (SSA) 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. Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST/CONGRESSIONAL ADD: Develop, demonstrate, and integrate space situational awareness technology at the Maui Space Surveillance System (MSSS), as well as operate and upgrade the facility.	26.519	25.208	5.899	0.000	5.899
FY 2009 Accomplishments: In FY 2009: Continued MSSS infrastructure contributions in research, development, and operations that support various customers and experimenters. Continued refurbishing and upgrading MSSS to accommodate those missions and maintaining requirements for safety and security in accordance with Air Force regulations. Continued development and implementation of self-sufficiency plan. This effort includes Congressional Add of \$22.0 million in FY 2009.					
<i>FY 2010 Plans:</i> 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					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603444F: MAUI SPACE SURVE SYSTEM	EILLANCE	<b>PROJECT</b> 634868: <i>Ma</i>	<b>T</b> Maui Space Surveillance System			
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
and implementation of self-sufficiency plan. This effort include FY 2010.	es Congressional Add of \$19.5 million in						
FY 2011 Base Plans: In FY 2011: Continue MSSS infrastructure contributions in rest that support various customers and space situational awarene Continue refurbishing and upgrading MSSS to accommodate requirements for safety and security in accordance with Air Fo and implementation of self-sufficiency plan.	ess research and demonstrations. those missions and maintaining						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
Ассо	mplishments/Planned Programs Subtotals	26.519	25.208	5.899	0.000	5.89	
		FY 2009	FY 2010	]			
Congressional Add: Panoramic Survey Telescope And Rapid Res <i>FY 2009 Accomplishments:</i> In FY 2009: Pan-STARRS Prototype on Maui began its three sky mapping. AF used its five percent allocation of telescope Procurement for the second telescope has begun. The Enviro telescope system on Mauna Kea has begun. <i>FY 2010 Plans:</i>	year mission of asteroid hunting and time for military utility determination.	7.978	9.461				
In FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Pan-	STARRS.						
		1.596	1.992				

		DATE: Feb	oruary 2010	
<b>PROJECT</b> 634868: <i>M</i> a		aui Space S	urveillance S	System
	1			
FY 2010	FY 2010	]		
11.453	11.453	_		
L				
			Cost To	
FY 2014	FY 2014	FY 2015	-	Total Cos
0.000				
0.000	0.000	0.000	0.000	0.00
0.000	0.000	0.000	0.000	0.00
0.000	0.000	0.000	0.000	0.00
0.000	0.000	0.000	0.000	0.00
0.000	0.000	0.000	0.000	0.00
0.000	0.000	0.000	0.000	0.00

Exhibit R-2A, RDT&E Project Just	t <b>ification</b> : PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIN 3600: Research, Development, Test BA 3: Advanced Technology Develo	t & Evaluation	,		<b>R-1 ITEM N</b> PE 0603444 <i>SYSTEM</i>		<b>PROJECT</b> 634868: <i>Maui Space Surveillance System</i>					
C. Other Program Funding Summ			FY 2011	FY 2011	FY 2011					Cost To	- /
<u>Line Item</u> • PE 0603883C: <i>Ballistic Missile</i> <i>Defense Boost Phase Segment.</i>	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	<u>000</u>	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>F Y 2015</u>	<u>Complete</u>	<u>iotai Cos</u>
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, RDT&E Budget Item	Justification	: PB 2011 A	ir Force				DATE: February 2010				
APPROPRIATION/BUDGET ACT 3600: Research, Development, Tes BA 3: Advanced Technology Devel	st & Evaluatio			<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	0.000	27.390	24.814	0.000	24.814	27.874	28.774	30.291	31.812	Continuing	Continuing
635323: Directed Energy Bioeffects Parameters	0.000	1.696	2.270	0.000	2.270	2.520	2.459	2.545	2.643	Continuing	Continuing
635324: Human Dynamics and Terrain Demonstration	0.000	6.233	6.426	0.000	6.426	6.745	6.711	8.897	9.720	Continuing	Continuing
635325: Mission Effective Performance	0.000	4.683	4.530	0.000	4.530	5.676	5.935	5.142	5.392	Continuing	Continuing
635326: Performance Enhancement Demonstration	0.000	7.465	4.377	0.000	4.377	4.572	4.546	4.704	4.941	Continuing	Continuing
635327: Warfighter Interfaces	0.000	7.313	7.211	0.000	7.211	8.361	9.123	9.003	9.116	Continuing	Continuing

#### <u>Note</u>

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 5325; Performance Enhancement Demonstration efforts will move from PE 0603231F, Project 5325; Performance Enhancement Demonstration efforts will move from PE 0603231F, Project 5326; and Warfighter Interfaces efforts will move from PE 0603231F, Project 2830 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 anticipate and influence during military operations. The Human Dynamics and Terrain Demonstration project develops, demonstrates, and transitions technologies to anticipate and influence

ibit R-2, RDT&E Budget Item Justification: PB 2011			TURE			
<ul> <li>D: Research, Development, Test &amp; Evaluation, Air Force</li> <li>B: Advanced Technology Development (ATD)</li> </ul>		-	Effectiveness Adv Tech	Dev		
versarial behavior within the air, space, and cyber doma	ins. This program i	is in Budget Activ	ity 3, Advanced Technol	ogy Development, sin	ce it develops	and
monstrates technologies to protect and enhance the pe	formance of Air For	rce personnel in o	operational environments	3.		
<u>rogram Change Summary (\$ in Millions)</u>						
	<u>FY 2009</u>	<u>FY 2010</u>	FY 2011 Base	FY 2011 OCO	FY 2011	Total
Previous President's Budget	0.000	24.565	0.000	0.000	(	0.000
Current President's Budget	0.000	27.390	24.814	0.000	24	4.814
Total Adjustments	0.000	2.825	24.814	0.000	24	4.814
<ul> <li>Congressional General Reductions</li> </ul>		0.000				
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000				
<ul> <li>Congressional Rescissions</li> </ul>	0.000	-0.115				
<ul> <li>Congressional Adds</li> </ul>		2.940				
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000				
Reprogrammings	0.000	0.000				
SBIR/STTR Transfer	0.000	0.000				
Other Adjustments	0.000	0.000	24.814	0.000	24	4.814
Congressional Add Details (\$ in Millions, and Inc	udes General Red	uctions)			FY 2009	FY 2010
Project: 635326: Performance Enhancement Demo	nstration					
Figet. 03320. Feromance Limancement Demo						
Congressional Add: Water for Injection and Air F	Purification with Carl	bon Nanotube Na	nostructured Materials.		0.000	2.92
-	Purification with Car		nostructured Materials. gressional Add Subtotals	for Project: 635326	0.000	2.92 2.92

In FY 2010, Congress added \$2.94 million for Water for Injection and Air Purification with Carbon Nanotube Nanostructured Materials.

C. Performance Metrics

xhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Fore	ce	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 600: Research, Development, Test & Evaluation, Air Force 3A 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech Dev</i>	
Under Development.		

Exhibit R-2A, RDT&E Project Just	stification: Pl	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITYR-1 ITEM NOMENCLATUREPROJECT3600: Research, Development, Test & Evaluation, Air ForcePE 0603456F: Human Effectiveness Adv Tech635323: DirectBA 3: Advanced Technology Development (ATD)DevParameters					-	y Bioeffects					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	1.696	2.270	0.000	2.270	2.520	2.459	2.545	2.643	Continuing	Continuing

#### <u>Note</u>

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 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate protective technologies for aircrew and ground personnel to provide protection against directed energy threats.	0.000	0.813	0.770	0.000	0.770
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
<i>FY 2010 Plans:</i> 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.					

R-1 Line Item #24 Page 4 of 25

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness</i> <i>Dev</i>	: Adv Tech	<b>PROJECT</b> 635323: Dii Parameters	rected Energ	y Bioeffects	
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Begin incorporating validated human systems into vulnerability models. Continue monitoring optical radiation ski radio frequency radiation personnel protection technologies. I and simulation of the bioeffects of high energy directed energy</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: N/A</li> </ul>	n protection material technologies and nitiate research into advanced modeling					
MAJOR THRUST: Develop and demonstrate technologies to asse directed energy systems. <i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.	ess bioeffects and collateral hazards from	0.000	0.883	1.500	0.000	1.500
FY 2010 Plans: In FY 2010: Combine angular-dependent and individual/crowd energy parameters. Integrate target effects across directed er tool development. Conduct field validation studies of model pr for mission planning tools.	nergy spectrum into collateral damage					
FY 2011 Base Plans: In FY 2011: Perform field and laboratory experiments to verify assessment software models on high energy laser systems an energy hazard assessment tools. Initiate software developme effects from collateral hazard predictions into war-gaming scer of collateral hazard predictions for near real-time modules for planning applications.	nd evaluate next generation of directed nt to incorporate directed energy human narios. Increase computational speed					

Exhibit R-2A, RDT&E Project Just	tification: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010		
BA 3: Advanced Technology Develo	Development, Test & Evaluation, Air Force PE 0603456F: Human Effectiveness Adv Tech 635323: Technology Development (ATD) Dev Paramet							<b>PROJECT</b> 635323: <i>Dir</i> <i>Parameters</i>	Directed Energy Bioeffects			
B. Accomplishments/Planned Pro	ogram (\$ in M	lillions <u>)</u>					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 OCO Plans: In FY 2011 OCO: N/A												
			Accomplish	nments/Plann	ed Program	s Subtotals	0.000	1.696	2.270	0.000	2.270	
C. Other Program Funding Summ	ary (\$ in Mill	<u>ions)</u>										
			FY 2011	<u>FY 2011</u>	<u>FY 2011</u>					Cost To		
Line Item	FY 2009	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<b>Complete</b>	Total Cost	
• PE 0602202F: Human	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Effectiveness Applied Research. • PE 0603231F: Crew Systems and Personnel Protection Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
<b>D. Acquisition Strategy</b> 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, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
3600: Research, Development, Test & Evaluation, Air Force					<b>IOMENCLA</b> 6F: <i>Human I</i>	<b>TURE</b> Effectiveness	s Adv Tech	PROJECT 635324: Human Dynamics and Terrain Demonstration			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	6.233	6.426	0.000	6.426	6.745	6.711	8.897	9.720	Continuing	Continuing

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop, mature, and demonstrate technology to provide mission-essential capabilities for AF cyber operator performance enhancement and situational awareness.	0.000	2.188	2.365	0.000	2.36
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
FY 2010 Plans: 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.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectivenes</i> <i>Dev</i>	<b>PROJECT</b> 635324: Human Dynamics and Terrain Demonstration				
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Develop technologies to increase cyber operator s Evaluate suitability of technologies to transition cyber operator operations technologies designed to anticipate and influence and integrate, demonstrate, and evaluate readiness for transition of performance within cyber domain operations.	tools that integrate advanced influence n adversary's behavior. Identify,					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop/demonstrate human-centered design pr optimize ISR information flows in a distributed, multi-source mission		0.000	0.990	1.045	0.000	1.045
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Develop and demonstrate automated tools and tec intelligence analyst's data overload condition and improve prod development in the areas of ISR processes, ISR mission plann centric automated services to increase ISR enterprise capabiliti reducing complexity, cost, and intelligence production cycle tim technologies for ISR dynamic planning, geospatial intelligence operations tools used in AF ISR weapons systems. Develop an anticipatory approaches to enhance command, control, and intel	uctivity. Concentrate technology ing, and tool integration utilizing net- ies, effectiveness, and quality, while es. Demonstrate and transition tools, and multi-INT information and assess the effectiveness of					
FY 2011 Base Plans: In FY 2011: Develop and demonstrate advanced ISR analyst p validate, and transition human-centric decision-aids, tools, and						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Ac</i> <i>Dev</i>	dv Tech	<b>PROJECT</b> 635324: Hu Demonstrat	luman Dynamics and Terrain		
B. Accomplishments/Planned Program (\$ in Millions)						
	F	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
computer-based ISR system tools and related techniques sup an emphasis on anticipatory approaches to enhance comman mature, assess, and transition tools designed to increase ISR interactions between humans and their automated planning ar <i>FY 2011 OCO Plans:</i>	d, control, and intelligence. Develop, productivity by focusing on the					
In FY 2011 OCO: N/A						
MAJOR THRUST: Develop/demonstrate anticipatory C2I decision- battlefield situation, predict likely adversary behaviors, and select/p <i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable. <i>FY 2010 Plans:</i>		0.000	1.100	0.495	0.000	0.495
In FY 2010: Integrate decision-aiding tools into identified tech Evaluate the methodologies developed to quantifiably measur predictive environment decision aids and simulation tools. Re analysis and the anticipation elements. Evaluate the expande decision aid tools and simulation in field exercises.	e the effectiveness of the commander's fine tools with emphasis on intelligence					
FY 2011 Base Plans: In FY 2011: Evaluate the suitability, maturity, and readiness of technologies for transition to JFC/JFACC component users. In products.	•					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
		0.000	1.955	2.521	0.000	2.521

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness</i> <i>Dev</i>	Adv Tech	PROJECT 635324: Hu Demonstrat	ain		
B. Accomplishments/Planned Program (\$ in Millions)	·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop/demonstrate technology to optimize hur modeling techniques, and automated speech translation tools to aid						
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Identify, integrate, demonstrate, and transition tec performance within AF influence operations. Illustrate adversa used to gauge adversarial threats. Mature and transition resea performance training effectiveness, mission rehearsal, simulating quantitative measures of effectiveness for psychological operation capabilities. Develop and demonstrate next-generation information capabilities yielding non-kinetic warfighting options. Demonstrate speech translation tools which support automated, cross-culture	rial cultural modeling techniques arch into influence operations human ons, and combat readiness. Mature tions and selected influence operations ation operations and cyber influence ate and transition advanced speech-to-					
FY 2011 Base Plans: In FY 2011: Demonstrate and determine the suitability, maturit information operations and cyber influence capabilities which y Demonstrate and assess the effectiveness of advanced advers used to gauge adversarial threats and behavior signatures. De the suitability of technology to transition advanced speech-to-sp automated, cross-cultural communications. Validate and impro- measures of effectiveness for selected AF influence operations	ield non-kinetic warfighting options. sarial cultural modeling techniques evelop, demonstrate, and assess peech translation tools that support ove models used to demonstrate					
FY 2011 OCO Plans: In FY 2011 OCO: N/A						
Accor	nplishments/Planned Programs Subtotals	0.000	6.233	6.426	0.000	6.426

Exhibit R-2A, RDT&E Project Just	tification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				PE 0603456F: Human Effectiveness Adv Tech 63532					<b>PROJECT</b> 635324: Human Dynamics and Terrain Demonstration				
C. Other Program Funding Summ	ary (\$ in Mill	ions)											
			<u>FY 2011</u>	FY 2011	FY 2011					Cost To			
Line Item	FY 2009	<u>FY 2010</u>	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<b>Complete</b>	Total Cost		
• PE 0602202F: <i>Human</i> <i>Effectiveness Applied Research.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
• PE 0603231F: Crew Systems and Personnel Protection Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
<b>D. Acquisition Strategy</b> 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, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)					<b>IOMENCLA</b> 6F: <i>Human I</i>	<b>TURE</b> Effectivenes	s Adv Tech	<b>PROJECT</b> 635325: <i>Mission Effective Performance</i>				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
635325: <i>Mission Effective</i> <i>Performance</i>	0.000	4.683	4.530	0.000	4.530	5.676	5.935	5.142	5.392	Continuing	Continuing	

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Advance aerospace/organizational behavior models for integrated warfighter training and rehearsal. Add realistic operations, command and control, force protection, and air base defense.	0.000	2.339	1.753	0.000	1.753
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
<i>FY 2010 Plans:</i> 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					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness</i> <i>Dev</i>	Adv Tech	<b>PROJECT</b> 635325: <i>Mi</i>	<b>PROJECT</b> 635325: <i>Mission Effective Performanc</i>			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
training for close air support and air-to-ground coordination. C rehearsal, and exercise evaluations and demonstrations in LVC command and control. Demonstrate integration of distributed a teams with tactical LVC operations for kill-chain training and op mission operations (DMO) training exemplars and conduct mis integration into routine operations training events. Complete d and mission planning and after action review toolsets and upda evaluation and training assessment.	C contexts for close air support and air and space operations center (AOC) perations. Field deployable distributed sion impact evaluations on their evelopment for deployable trainers						
FY 2011 Base Plans: In FY 2011: Complete field deployment and evaluation of emb and reporting system for combat mission readiness. Develop management system for distributed mission operations and LV Develop and evaluate an integrated environment for learning a virtual, and constructive air operations center planners, ground support aircraft, terminal attack and control personnel, and air and field assessment of tailored training inside the ready aircree mission types for at least three mission areas and operational interface and data control approaches for managing learning in	oreliminary functionality for a learning C training, rehearsal, and exercise. nd assessment that includes live, command and control, close air combat assets. Complete development w program allocation of sorties and systems. Develop specifications for						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop/demonstrate high-fidelity DMO training/ and electronic warfare (EW) training technologies for future threat s		0.000	2.344	2.777	0.000	2.777	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness</i> <i>Dev</i>	Adv Tech	<b>PROJECT</b> 635325: <i>Mi</i>	PROJECT 635325: Mission Effective Performanc			
3. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2010 Plans: In FY 2010: Develop the integrated strategy and plans division training requirements and optimum mission rehearsal strategies between component simulations and AOC equipment systems execution management capabilities for the simulation set. Be common database generation system and live EW range integrange live fly of LVC EW training with live emitters/platforms.</li> <li>FY 2011 Base Plans: In FY 2011: Develop code, integrate, and test the execution r simulation set. Develop, integrate, and test the performance a simulation set. Develop scenario authoring tools and integrate and integrate the entire strategy and plans division trainer and task trainer. Develop vendor-specific real-time database exart system's outputs. Begin development of methodologies for rechomeland security, and C4ISR databases. Demonstrate a mutraining concept. Conduct an integrated, on board EW training with a major test/training range.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	es. Develop individual interfaces s. Begin to code, integrate, and test the gin development of a DMO and C2ISR gration into DMO. Demonstrate an on- management capabilities for the assessment capability within the e with simulation components. Test I begin integration with the AOC part mples from the database generation eal-time incorporation of data into DMO, ulti-ship/onboard networked LVC EW						
	mplishments/Planned Programs Subtotals	0.000	4.683	4.530	0.000	4.53	

Exhibit R-2A, RDT&E Project Just	tification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develo	t & Evaluation	, Air Force		<b>R-1 ITEM N</b> PE 0603456 <i>Dev</i>			Adv Tech	<b>PROJECT</b> 635325: <i>Mi</i>	<b>JECT</b> 25: <i>Mission Effective Performanc</i>			
C. Other Program Funding Summ	ary (\$ in Mill	ions)										
		-	FY 2011	FY 2011	FY 2011					Cost To		
Line Item	FY 2009	<u>FY 2010</u>	Base	000	Total	FY 2012	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	Complete	<b>Total Cost</b>	
• PE 0602202F: <i>Human</i> <i>Effectiveness Applied Research.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0603231F: Crew Systems and Personnel Protection Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
<b>D. Acquisition Strategy</b> 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, RDT&E Project Jus	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force									DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)					<b>IOMENCLA</b> 6F: <i>Human I</i>	<b>TURE</b> Effectiveness	s Adv Tech	<b>PROJECT</b> 635326: Performance Enhancement Demonstration					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost		
635326: Performance Enhancement Demonstration	0.000	7.465	4.377	0.000	4.377	4.572	4.546	4.704	4.941	Continuing	Continuing		

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop/demonstrate tailored bio-taggant and identification/neutralization capabilities to enhance force protection/enable air operations commanders to maintain operations tempo.	0.000	1.702	1.925	0.000	1.925
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
FY 2010 Plans: 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.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectivenes</i> <i>Dev</i>	s Adv Tech		PROJECT 635326: Performance Enhancement Demonstration			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
Evaluate taggant technologies in simulated operational enviro capabilities to track biological warfare agents inside buildings							
FY 2011 Base Plans: In FY 2011: Complete the development of the rapid, hand-he platforms and transition to the warfighter. Conduct research t warfare agents inside buildings and vehicles.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop/demonstrate technologies for improve performance in known toxic environments, and identification of different sectors.		0.000	2.835	2.452	0.000	2.45	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Develop methods to identify key human threat in requirements and enable real-time threat assessment from th visualization techniques that integrate heterogeneous sensor	e air. Develop enhanced anthropometric						
FY 2011 Base Plans: In FY 2011: Demonstrate a human morphable digital model t and predicts both threat and the combination of sensing syste of predictions. Demonstrate new human threat awareness, vi capabilities for the deployed Airmen. Develop techniques to a information to relevant AF missions.	ms needed to increase the precision sualization, and risk assessment						

Exhibit R-2A, RDT&E Project Jus	tification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIN 3600: Research, Development, Tes BA 3: Advanced Technology Develo	t & Evaluation	, Air Force		<b>R-1 ITEM N(</b> PE 0603456 <i>Dev</i>	-	-	Adv Tech	PROJECT 635326: Pe Demonstra	Performance Enhancement			
B. Accomplishments/Planned Pro	ogram (\$ in M	illions)						1				
	•	ŗ					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A												
			Accomplish	ments/Plann	ed Program	s Subtotals	0.000	4.537	4.377	0.000	4.37	
							FY 2009	FY 2010	]			
							0.000	2.928				
Congressional Add: Water for Injer Materials.	ction and Air F	Purification w	ith Carbon I	Nanotube Na	nostructured	1						
FY 2009 Accomplishments: In FY 2009: Not Applicable.												
FY 2010 Plans: In FY 2010: Conduct Congres Carbon Nanotube Nanostructu		ed effort for	Water for Inj	ection and A	ir Purificatio	n with						
				Congre	ssional Add	s Subtotals	0.000	2.928				
C. Other Program Funding Summ	nary (\$ in Mill	ions)										
			FY 2011	<u>FY 2011</u>	FY 2011					Cost To		
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	FY 2012	<u>FY 2013</u>	<u>FY 2014</u>		<u>Complete</u>		
• PE 0602202F: Human	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Effectiveness Applied Research.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
				UNCLAS	SIFIED							

Exhibit R-2A, RDT&E Project Just	ification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test 3A 3: Advanced Technology Develo	& Evaluation	, Air Force		<b>R-1 ITEM N</b> PE 0603456 <i>Dev</i>			PROJECT 635326: Performance Enhancement Demonstration				
C. Other Program Funding Summa	arv (\$ in Milli	ions)		1				1			
▶ Line Item ▶ PE 0603231F: Crew Systems	FY 2009	FY 2010	<u>FY 2011</u> <u>Base</u>		<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Cost To</u> Complete	Total Co
and Personnel Protection Technology.											
<b>D. Acquisition Strategy</b> Not Applicable.											
E. Performance Metrics Please refer to the Performance Ba Force performance goals and most					/ Air Force n	esources are	applied an	d how those	resources a	re contributi	ng to Air

Exhibit R-2A, RDT&E Project Jus	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force								DATE: February 2010			
APPROPRIATION/BUDGET ACTIN 3600: Research, Development, Tes BA 3: Advanced Technology Develo	t & Evaluatio			<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness Adv Tech</i> <i>Dev</i>				ch 635327: Warfighter Interfaces				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
635327: Warfighter Interfaces	0.000	7.313	7.211	0.000	7.211	8.361	9.123	9.003	9.116	Continuing	Continuing	

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop/demonstrate technologies in a collaborative interface infrastructure to facilitate team building, sensemaking, and workflow in a globally distributed, net-centric C2 environment.	0.000	0.906	1.550	0.000	1.550
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
FY 2010 Plans: 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.					
	]				

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness</i> <i>Dev</i>	s Adv Tech	<b>PROJECT</b> 635327: <i>Warfighter Interfaces</i>			
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Develop flexible and modular proof-of-concept inter intense collaboration, sensemaking, distributed decision support used by C2 collaborators under cyber fight-through conditions ar mission assurance activities. Begin to integrate and test functior tools for demonstration in various C2 team decision making envi demonstrations in representative users' cyber environments.	, and workflow. These tools will be nd when conducting cyber-supported nality of the modular distributed					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop/demonstrate technologies to interface be controllers and multiple machine components through unified visual a Airmen.		0.000	2.709	1.500	0.000	1.500
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Develop integrated multisensory interfaces for grou Develop and demonstrate advanced cabling and wireless techno decrease system setup time, and reduce the probability of user e Demonstrate integrated human-centered concepts for enhanced usability. Refine audio and visual interfaces to enhance operato effectiveness, and allow effective use of wearable computers wit dismounted combat controllers.	blogies to improve operator mobility, errors or system malfunctions. I portability, maintainability, and r survivability, improve communication					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness</i> <i>Dev</i>	PE 0603456F: Human Effectiveness Adv Tech 635327:				
B. Accomplishments/Planned Program (\$ in Millions)	·					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2011 Base Plans: In FY 2011: Complete final evaluations of integrated component concept, including advanced audio, speech, and visual interfact applications, wearable power management systems, and ergor concepts. Conduct laboratory evaluations to assess effectivent performance to original baseline. Conduct field evaluations of t transition to operational capability.</li> <li>FY 2011 OCO Plans:</li> </ul>	es, improved human-centric software nomically improved cabling and carriage ess of integrated system and compare					
MAJOR THRUST: Develop/demonstrate supervisory-level interface	s between around controllers and	0.000	1.386	1.458	0.000	1.458
<ul> <li>multiple, highly autonomous UAS that optimize net-centric information of the second provident of the second provident</li></ul>	on flow to system operators. logies permitting the effective conduct et acquisition missions either by a n supervisory control station. Integrate and decision aids with multi-UAS eneration supervisory control station.	0.000			0.000	1.400
FY 2011 Base Plans: In FY 2011: Complete the development of advanced multi-UAS reconnaissance, surveillance, and time-critical target acquisition						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness</i> <i>Dev</i>	s Adv Tech	<b>PROJECT</b> 635327: <i>Wa</i>	arfighter Inter	faces	
B. Accomplishments/Planned Program (\$ in Millions)	,					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
cooperative engagement algorithms and operator interface te Complete the demonstration and assessment of system perforence enabled by the next-generation supervisory control station, us flight test environments. Determine how many vehicles a UA supervise.	ormance and mission effectiveness sing high-fidelity virtual simulation and					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop and demonstrate advanced job perfor human interaction with complex planning algorithms.	mance aiding technologies, emphasizing	0.000	0.498	1.112	0.000	1.112
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Begin to develop a visual interface concept that primary constraints within capacity-based planning. Include a that exploit cognitive engineering and work-centered design p featuring interactive simulations as a way to optimize resource deployments.	alternative planning algorithms principles. Outline a program plan					
FY 2011 Base Plans: In FY 2011: Develop visual interface and incorporate advance mobility operations. Demonstrate the ability to exploit automa resources within Joint Deployment and Distribution Enterprise time operator interaction within the capacity-based planner and human-automation interaction relative to current capabilities.	ated planning to optimize the use of e capacity constraints. Provide for real-					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603456F: <i>Human Effectiveness</i> <i>Dev</i>	Adv Tech	<b>PROJECT</b> 635327: Warfighter Interfaces				
B. Accomplishments/Planned Program (\$ in Millions)							
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop/demonstrate cognitive-based analytic/ tools for C2 operations to synchronize personnel in distributed loca		0.000	1.814	1.591	0.000	1.591	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Begin analysis and refine analytic methods and t for large, cross-organizational C2 teams and teams-of-teams. extensible work-aiding framework that integrates future and c framework that affords efficient and effective action of large di and individuals.	Begin concept development of an urrent work aids into a coherently unified						
FY 2011 Base Plans: In FY 2011: Demonstrate and evaluate a unifying C2 work-ai cross-organizational teams and individuals, including integrati tools. Examine results and refine work-centered analytic, des techniques as applied to teams.	on of a representative set of existing						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
	omplishments/Planned Programs Subtotals	0.000	7.313	7.211	0.000	7.211	

Exhibit R-2A, RDT&E Project Just	tification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develo	t & Evaluation	, Air Force		<b>R-1 ITEM N</b> PE 0603456 <i>Dev</i>			Adv Tech	<b>PROJECT</b> 635327: <i>Wa</i>	arfighter Inte	rfaces	
C. Other Program Funding Summ	ary (\$ in Mill	ions)									
			FY 2011	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	<u>FY 2010</u>	Base	000	Total	FY 2012	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	Complete	<b>Total Cost</b>
• PE 0602202F: Human	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Effectiveness Applied Research.											
• PE 0603231F: Crew Systems	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
and Personnel Protection											
Technology.											
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, RDT&E Budget Item	Justification	<b>:</b> PB 2011 A	ir Force						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Tes BA 3: Advanced Technology Develo	t & Evaluatio			<b>R-1 ITEM NOMENCLATURE</b> PE 0603601F: Conventional Weapons Technology							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	16.771	14.296	15.755	0.000	15.755	19.357	20.086	20.337	17.693	Continuing	Continuing
63670A: Conventional Weapons Development	16.771	14.296	15.755	0.000	15.755	19.357	20.086	20.337	17.693	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 2009	<u>FY 2010</u>	FY 2011 Base	FY 2011 OCO	<u>FY 2011</u>	Total
Previous President's Budget	17.166	14.356	0.000	0.000		0.000
Current President's Budget	16.771	14.296	15.755	0.000	1	5.755
Total Adjustments	-0.395	-0.060	15.755	0.000	1	5.755
<ul> <li>Congressional General Reductions</li> </ul>		0.000				
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000				
<ul> <li>Congressional Rescissions</li> </ul>	0.000	-0.060				
Congressional Adds		0.000				
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000				
Reprogrammings	0.000	0.000				
SBIR/STTR Transfer	0.000	0.000				
Other Adjustments	-0.395	0.000	15.755	0.000	1	5.755
ongressional Add Details (\$ in Millions, and Inc	ludes General Redu	<u>ictions)</u>		Γ	FY 2009	FY 2010
Project: 63670A: Conventional Weapons Developm	nent					
Congressional Add: Energetic Device Quality a	nd Reliability Improve	ements Usina Co	mputer Aided Process	Control	2.393	0.00

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	e DA	TE: February 201	0
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603601F: <i>Conventional Weapons Technology</i>		
Congressional Add Details (\$ in Millions, and Includes G	eneral Reductions)	FY 2009	FY 2010
Congressional Add: Integrated Targeting Devices.		2.992	0.000
	Congressional Add Subtotals for Project: 6367	DA 5.385	0.000
	Congressional Add Totals for all Proje	ts 5.385	0.000

#### **Change Summary Explanation**

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

C. Performance Metrics

(U) Under Development.

Exhibit R-2A, RDT&E Project Just	tification: Pl	3 2011 Air Fo	orce						DATE: Feb	ruary 2010	
3600: Research, Development, Test	APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 3: Advanced Technology Development (ATD)			<b>R-1 ITEM NOMENCLATURE</b> PE 0603601F: <i>Conventional Weapons</i> <i>Technology</i>				<b>PROJECT</b> 63670A: Conventional Weapons Development			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
63670A: Conventional Weapons Development	16.771	14.296	15.755	0.000	15.755	19.357	20.086	20.337	17.693	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate advanced air-delivered munitions fuze and mass-focusing warhead technologies to improve munition effectiveness.	2.666	3.440	0.000	0.000	0.00
FY 2009 Accomplishments: In FY 2009: Continued development of an active imaging target device that can provide warhead aimpoint selection for mass focused warheads.					
FY 2010 Plans: In FY 2010: Complete development of an active imaging target device that can provide warhead aimpoint selection for mass focused warheads.					
FY 2011 Base Plans: In FY 2011: Not Applicable.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603601F: Conventional Weapo Technology	<b>PROJECT</b> 63670A: Co	onventional V	Veapons De	velopment	
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate conventional munition innovative air-delivered munition carriage and release equipment a		0.258	4.696	13.203	0.000	13.203
FY 2009 Accomplishments: In FY 2009: Began developing a missile with the capability to agile air targets as well as high value ground targets, such as						
FY 2010 Plans: In FY 2010: Continue development of a small short-range pre- attacking multiple moving targets. Continue developing a mis range of small and highly agile air targets as well as high valu defenses. Begin developing a conventional ordnance packag and explosive fill capable of penetrating high performance cor	sile with the capability to defeat a broad e ground targets, such as enemy air e consisting of a case, fuze, fuzewell,					
FY 2011 Base Plans: In FY 2011: Continue development of a small short range pre- attacking multiple moving targets. Continue developing a mis range of small and highly agile air targets as well as high valu defenses. Continue developing a conventional ordnance pack and explosive fill capable of penetrating high performance cor	sile with capability to defeat a broad e ground targets, such as enemy air kage consisting of a case, fuze, fuzewell,					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate advanced convention destroy hardened targets.	nal armament warhead technologies to	3.159	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603601F: Conventional Weapo Technology	ons	<b>PROJECT</b> 63670A: Co	onventional V	Veapons De	velopment
B. Accomplishments/Planned Program (\$ in Millions)	'		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2009 Accomplishments: In FY 2009: Demonstrated an ordnance package with improvemissile and counter-air targets, as well as attacking a subset of defenses. Demonstrated a multi-mode warhead package des</li> <li>FY 2010 Plans: In FY 2010: Not Applicable.</li> <li>FY 2011 Base Plans: In FY 2011: Not Applicable.</li> <li>FY 2011 OCO Plans:</li> </ul>	of ground targets to include enemy air					
In FY 2011 OCO: N/A. MAJOR THRUST: Develop and demonstrate advanced convention		5.303	3.446	0.500	0.000	0.500
<ul> <li>miniature munitions application to increase the probability of kill an</li> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Continued design and demonstration of a low co</li> <li>to increase data rates and LADAR moving parts compared to</li> <li>technologies. Flight tested a multi-mode radar seeker capable</li> <li>targets in adverse weather.</li> </ul>	st laser detection ordnance seeker earlier generation LADAR seeker					
FY 2010 Plans: In FY 2010: Complete demonstration of a low cost laser dete rates. Investigate the design details for a low cost multispectr weather operation.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603601F: Conventional Weapor Technology	ns	<b>PROJECT</b> 63670A: Co	onventional V	Veapons De	velopment
B. Accomplishments/Planned Program (\$ in Millions)	,		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Complete design trades and select an approach to weather seeker.	o a multispectral autonomous all					
FY 2011 OCO Plans: In FY 2011 OCO: N/A.						
MAJOR THRUST: Develop and demonstrate advanced convention technologies to improve armament navigation accuracy, stand off ra operation.		0.000	2.714	2.052	0.000	2.052
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
<i>FY 2010 Plans:</i> In FY 2010: Develop a small guided sub-munition to attack mu	ltiple moving targets.					
FY 2011 Base Plans: In FY 2011: Demonstrate a small guided sub-munition capable	e of attacking moving targets.					
FY 2011 OCO Plans: In FY 2011 OCO: N/A.						
Accon	nplishments/Planned Programs Subtotals	11.386	14.296	15.755	0.000	15.755
				7		
		FY 2009	FY 2010	-		
Congressional Add: Energetic Device Quality and Reliability Impro	ovements Using Computer Aided Process	2.393	0.000			

Exhibit R-2A, RDT&E Project Just	stification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTI 3600: Research, Development, Tes BA 3: Advanced Technology Devel	st & Evaluation	, Air Force		<b>R-1 ITEM N</b> PE 0603601 <i>Technology</i>	-	-	ns	<b>PROJECT</b> 63670A: Co	onventional	Neapons De	evelopme
B. Accomplishments/Planned Pr	ogram (\$ in M	lillions)									
							FY 2009	FY 2010	]		
FY 2009 Accomplishments: In FY 2009 : Conducted Cong Improvements Using Compute			for Energeti	c Device Qua	ality and Rel	iability					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
							2.992	0.000	_		
Congressional Add: Integrated Ta	argeting Device	s.									
FY 2009 Accomplishments: In FY 2009: Conducted Cong	ressionally-dire	ected effort f	for Integrated	d Targeting [	Devices.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
				Congre	ssional Add	s Subtotals	5.385	0.000			
C. Other Program Funding Sumr	narv (\$ in Mill	ions)									
		<i>F</i>	<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<b>Base</b>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>		<u>Complete</u>	
• PE 0602602F: <i>Conventional</i> <i>Munitions.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
<b>D. Acquisition Strategy</b> Not Applicable.											
E. Performance Metrics Please refer to the Performance I Force performance goals and mo					Air Force re	esources are	e applied an	d how those	resources a	re contribut	ing to Air

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Exhibit R-2, RDT&E Budget Item	Justification	: PB 2011 A	ir Force						DATE: February 2010		
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Tes BA 3: Advanced Technology Develo	t & Evaluatio				IOMENCLA <sup>®</sup> 5F: Advance	<b>TURE</b> ed Weapons					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	61.420	44.794	17.461	0.000	17.461	28.683	32.749	34.542	35.944	Continuing	Continuing
6311SP: Advanced Optics and Laser Space Tech	15.477	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
633150: Advanced Optics Technology	10.970	9.460	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
633151: Lasers and Imaging Development and Integration	26.467	21.965	6.883	0.000	6.883	16.487	21.563	22.887	23.452	Continuing	Continuing
633152: High Power Microwave Development and Integration	8.506	13.369	10.578	0.000	10.578	12.196	11.186	11.655	12.492	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.

hibit R-2, RDT&E Budget Item Justification: PB 2011 Air F	orce			DATE:	February 2010	)
<b>PROPRIATION/BUDGET ACTIVITY</b> 00: Research, Development, Test & Evaluation, Air Force 3: Advanced Technology Development (ATD)		EM NOMENCLA 03605F: Advance	NTURE ed Weapons Technolog	у		
Program Change Summary (\$ in Millions)						
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	<u>FY 2011</u>	
Previous President's Budget	56.283	30.056	0.000	0.000		0.000
Current President's Budget	61.420	44.794	17.461	0.000		7.461
Total Adjustments <ul> <li>Congressional General Reductions</li> </ul>	5.137	14.738 -0.015	17.461	0.000	1	7.461
Congressional Directed Reductions		0.000				
Congressional Rescissions	0.000	-0.187				
Congressional Adds	0.000	14.940				
Congressional Directed Transfers		0.000				
Reprogrammings	0.000	0.000				
SBIR/STTR Transfer	0.000	0.000				
Other Adjustments	5.137	0.000	17.461	0.000	1	7.461
Congressional Add Details (\$ in Millions, and Include	s General Red	uctions)			FY 2009	FY 201
Project: 633150: Advanced Optics Technology						
Congressional Add: Compound Zoom for Airborne R	econnaissance	(CZAR).		_	1.197	0
Congressional Add: Applications of LIDAR to Vehicle	es with Analysis	(ALVA).			6.981	5
Congressional Add: Real-time Optical Surveillance A	Applications (RC	ISA).			2.792	3.
		Cong	ressional Add Subtotals	s for Project: 633150	10.970	9.
Project: 633151: Lasers and Imaging Development and	Integration			-		
Congressional Add: Advanced Tactical Laser.				-	0.000	2.
Congressional Add: Advanced Fiber Lasers Systems	s and Compone	nts.		-	0.957	3
		Cong	ressional Add Subtotals	s for Project: 633151	0.957	5.
			Congressional Add 1	otals for all Projects	11.927	14

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603605F: <i>Advanced Weapons Technology</i>	

#### **Change Summary Explanation**

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

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 2010, Congress added \$3.2 million for Advanced Fiber Lasers Systems and Components, \$6.0 million for Applications of LIDAR to Vehicles with Analysis, \$3.5 million for Real-time Optical Surveillance Applications, and \$2.24 million for Advanced Tactical Laser.

C. Performance Metrics Under Development.

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Exhibit R-2A, RDT&E Project Ju	stification: Pl	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 3: Advanced Technology Deve	, Development, Test & Evaluation, Air Force Technology Development (ATD)				IOMENCLA 5F: Advance		Technology	PROJECT 6311SP: Advanced Optics and Laser Space Tech			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	15.477	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate optical technologies for space situational awareness applications.	4.365	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Integrated high efficiency adaptive optics system on large aperture high resolution telescope. Performed system tests and prepared for demonstrations of high resolution compensated imaging and detection of very dim space objects at visible and infrared wavelengths. Concluded phased array imaging experiments.					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.					
FY 2011 Base Plans: In FY 2011: Not Applicable.					

Exhibit R-2A, RDT&E Project Just	ification: PB	2011 Air Fo	orce						DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develop	& Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603605			Fechnology	PROJECT 6311SP: Ac Tech	<b>T</b> Advanced Optics and Laser Space		
B. Accomplishments/Planned Pro	gram (\$ in M	illions)						1			
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 OCO Plans: In FY 2011 OCO:  N/A											
MAJOR THRUST: Develop and depropagation through severe and/or a				ntrol technolo	ogies for las	er	11.112	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Completed design propagation through atmospher thrust has been moved to Proje align efforts.	ric turbulence	in a variety	of atmosphe	eric condition	s. In FY 20						
FY 2010 Plans: In FY 2010: Not Applicable.											
FY 2011 Base Plans: In FY 2011: Not Applicable.											
FY 2011 OCO Plans: In FY 2011 OCO:  N/A											
			Accomplish	ments/Plann	ed Program	s Subtotals	15.477	0.000	0.000	0.000	0.000
C. Other Program Funding Summa	ary (\$ in Mill	ions)									
	•	·	<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item • PE 0602605F: Directed Energy Technology	FY 2009 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	<u>0C0</u> 0.000	<u>Total</u> 0.000	FY 2012 0.000	<u>FY 2013</u> 0.000	<u>FY 2014</u> 0.000	<u>FY 2015</u> 0.000	<u>Complete</u> 0.000	<u>Total Cost</u> 0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce					DATE: February 2010				
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develop	& Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603605	-	-	Fechnology	PROJECT 6311SP: Ad Tech	vanced Opt	ics and Lase	er Space	
C. Other Program Funding Summa	ary (\$ in Milli	ions)										
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u> <u>Base</u>	<u>FY 2011</u> <u>OCO</u>	<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Cost To</u> Complete	Total Cost	
• PE 0603444F: <i>Maui Space</i>												
Surveillance System												
• PE 0601108F: <i>High Energy</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Laser Research Initiatives.												
• PE 0602890F: <i>High Energy</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Laser Research.												
• PE 0603924F: High Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Laser Advanced Technology												
Program.												
• PE 0602120A: Sensors and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Electronic Survivability.			0 000									
• PE 0602307A: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Weapons Technology.	0.000	0.000	0 000	0.000	0.000	0.000	0.000	0.000	0.000	0 000	0.000	
• PE 0602624A: Weapons and Munitions Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0603004A: Weapons and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Munitions Advanced Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0602114N: Power Projection	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Applied Research.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0602702E: Tactical	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0603175C: Ballistic Missile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Defense Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0603883C: Ballistic Missile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Defense Boost Phase Segment												
• PE 0602651M: Joint Non-Lethal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Weapons Applied Research.	-	_		-	-	_						
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Exhibit R-2A, RDT&E Project Ju	stification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 3: Advanced Technology Deve	est & Evaluation,	Air Force		<b>R-1 ITEM N</b> PE 0603605			Technology	<pre>PROJECT y 6311SP: Advanced Optics and Laser S Tech</pre>			
C. Other Program Funding Sum	mary (\$ in Millio	ons <u>)</u>									
Line Item • PE 0603651M: Joint Non- Lethal Weapons Technology Development.	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u> <u>Base</u>	<u>FY 2011</u> <u>OCO</u>	<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Cost To</u> <u>Complete</u>	
<b>D. Acquisition Strategy</b> Not Applicable.											
Force performance goals and mo	oot importantiy, i										

Exhibit R-2A, RDT&E Project Ju	ustification: Pl	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET AC 3600: Research, Development, T 3A 3: Advanced Technology Dev	est & Evaluatio	,			IOMENCLA 5F: Advance	<b>TURE</b> ed Weapons	Technology	<b>PROJECT</b> 633150: <i>Ac</i>	lvanced Opt	ics Technolo	gу
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
633150: Advanced Optics Technology	10.970	9.460	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuir
A. Mission Description and Bud This project develops advanced B. Accomplishments/Planned F	l optical techno	logies for va	rious strateg	ic and tactic	al beam con	trol application	ons.				
D. Accomplishments/Flamed P	<u>-rogram (# m i</u>	<u>viiiiioiis</u>							_		
							FY 2009	FY 2010	_		
Congressional Add: Compound	Zoom for Airbo	rne Reconn:	aissance (C2	74R)			1.197	0.000			
<i>FY 2009 Accomplishments:</i> In FY 2009: Completed criti and conduct preparation for plan.	cal design revie	ew of optical	system. Co	ontinued integ		•					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.											
Congressional Add: Applications	s of LIDAR to V	ehicles with	Analysis (Al	_VA).			6.981	5.975			
FY 2009 Accomplishments: In FY 2009: ALVA consists Continued development of a											

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force						DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM N</b> PE 0603605	-	-	- echnology	<b>PROJECT</b> 633150: <i>A</i> a	lvanced Opti	cs Technolo	gy
B. Accomplishments/Planned Program (\$ in Millions)	1							
				FY 2009	FY 2010			
(IEDs) and operational intel and targeting users such as Air Com Operations Command. Supported transition of militarily useful la deployment and flight testing. Integrated state-of-the-art sensors communications networks. Participated in war games and exerc detector with active tracking system. Continued research and da imaging of space objects and ranging applications. Developed of operations during the day.	asers for nighttim s into real-world a cises. Hi-Class: ata collection for	e video thro air frames ar Tested lase three dimen	ugh nd r ranging sional					
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for ALVA.								
Congressional Add: Real-time Optical Surveillance Applications (RO	ISA).			2.792	3.485			
FY 2009 Accomplishments: In FY 2009: Developed model-assisted autonomous algorithms Continued simulation-based studies of various means to exploit of photon counter for space situational awareness capabilities. Con end-to-end simulation environment of autonomous networked ele resource management schemes in support of space track and ca	data from ultra-se ntinued developn ectro-optical sens	ensitive time nent of high	-resolved fidelity					
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for ROSA.								
	Congre	ssional Add	s Subtotals	10.970	9.460			
C. Other Program Funding Summary (\$ in Millions)								
Line Item         FY 2009         FY 2010         Ba           • PE 0603444F: Maui Space         0.000         0.000         0.00	ise OCO	FY 2011 <u>Total</u> 0.000	<u>FY 2012</u> 0.000	<u>FY 2013</u> 0.000	<u>FY 2014</u> 0.000	<u>FY 2015</u> 0.000	Cost To Complete 0.000	<u>Total Co</u> 0.00
Surveillance Systems.								

Exhibit R-2A, RDT&E Project Just	i <b>fication:</b> PB	2011 Air Fo	rce					DATE: February 2010			
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develop		<b>R-1 ITEM NO</b> PE 0603605			Fechnology	<b>PROJECT</b> 633150: <i>Ad</i>	vanced Opti	cs Technolo	gу		
C. Other Program Funding Summa	ary (\$ in Mill	ions)									
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					Cost To	
Line Item • PE 0602605F: Directed Energy Technology.	<u>FY 2009</u> 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	<u>0C0</u> 0.000	<u>Total</u> 0.000	FY 2012 0.000	<u>FY 2013</u> 0.000	FY 2014 0.000	FY 2015 0.000	<u>Complete</u> 0.000	<u>Total Cost</u> 0.000

#### **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, RDT&E Project Jus	tification: PE	3 2011 Air F				DATE: Feb	ruary 2010					
3600: Research, Development, Tes	PROPRIATION/BUDGET ACTIVITY 0: Research, Development, Test & Evaluation, Air Force 3: Advanced Technology Development (ATD)				IOMENCLA 5F: Advance		Technology	<b>PROJECT</b> 633151: Lasers and Imaging Development and Integration				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	26.467	21.965	6.883	0.000	6.883	16.487	21.563	22.887	23.452	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 optical imaging, laser, and beam control technologies needed for applications such as aircraft self-protection, force protection, force application, precision engagement, and space situational awareness. 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 optically 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate laser technologies for applications such as aircraft self- protection.	5.729	2.223	2.693	0.000	2.693
<i>FY 2009 Accomplishments:</i> In FY 2009: Continued to develop electric lasers for aircraft self-protection. Continued to focus on reducing size and weight, as well as increasing efficiency, affordability, reliability, maintainability, supportability, operational environmental acceptability, and ruggedness. Completed integration of a 15 kilowatt solid state laser with an existing beam control subsystem for an integrated laboratory testbed to support multiple applications.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603605F: <i>Advanced Weapons</i>	Technology	<b>PROJECT</b> 633151: Lasers and Imaging Develop Integration		pment an		
B. Accomplishments/Planned Program (\$ in Millions)	I		1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2010 Plans: In FY 2010: Design, develop, and test aircraft self-protection of source and beam director capable of countering next generation imaging (focal plane array) technology.</li> <li>FY 2011 Base Plans: In FY 2011: Develop integrated breadboard aircraft self-protection</li> </ul>	on missile threats with seekers based on						
compatible with mid-wave infrared detection and jamming capa fly-out model codes with effects/lethality data. <i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A	abilities. Validate aircraft self-protection						
MAJOR THRUST: Develop and demonstrate advanced beam con tactical lasers with beam control.	trol technologies and evaluate integrated	19.781	6.192	4.190	0.000	4.19	
<ul> <li>FY 2009 Accomplishments:</li> <li>In FY 2009: Continued integrated tactical beam control field tercontour tracking algorithms and advanced jitter reduction in bread eveloping the second-generation relay mirror demonstrator contoucted airborne flight demonstrations of a tactical laser agric continued development and began integration and checkout of subsystems to allow integration of the solid state laser with a b demonstrations. Continued to prepare for integration of appropriating aircraft demonstration of electric laser-based precision end</li> </ul>	eadth of environments. Continued omponents. Completed preparations th solid state lasers in the laboratory. ainst ground targets. With DARPA, f beam control, and data analysis beam control system for ground						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603605F: <i>Advanced Weapons</i>	Technology	<b>PROJECT</b> 633151: <i>La</i> <i>Integration</i>	asers and Imaging Development ar			
B. Accomplishments/Planned Program (\$ in Millions)	I		1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2010 Plans: In FY 2010: Conduct advanced tactical beam control demonst subsystem development, integration, and checkout and condu to validate target acquisition, tracking, and beam pointing perfor DARPA solid state laser with a beam control system. Complet with the exception of integration with the laser device. Develo use of a solid state laser in a demonstration of a potential weat</li> <li>FY 2011 Base Plans: In FY 2011: Continue advanced tactical beam control develop DARPA, integrate the solid state laser device with the appropri complete checkout and subsystem performance testing in pre- demonstrations. Continue technology development for future laser and a beam control system on a large aircraft.</li> </ul>	ict low-power beam control field testing ormance to allow integration of the te systems integration and checkout, p appropriate technologies to allow the pon system capability on a large aircraft.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Develop, integrate, and demonstrate advanced space situational awareness applications.	technologies for various ground-based	0.000	8.132	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Build advanced ground diagnostic system for cha atmospheric turbulence. Begin to conduct assessment of syst atmospheric conditions. Conduct brassboard integration of ad technologies. Based on changes in space acquisition, the rem	tem performance in a variety of Ivanced sensing and wavefront control						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603605F: <i>Advanced Weapons Te</i>	echnology	<b>PROJECT</b> 633151: Lasers and Imaging Develop Integration		pment an	
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
to PE 0602605F, Directed Energy Technology in order to better r transition opportunities in the future.	natch available technology with					
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
Accomp	ishments/Planned Programs Subtotals	25.510	16.547	6.883	0.000	6.88
		FY 2009	FY 2010	]		
Congressional Add: Advanced Tactical Laser.		0.000	2.231			
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congressionally-directed effort for Advance	d Tactical Laser.					
Congressional Add: Advanced Fiber Lasers Systems and Component	ts.	0.957	3.187			
FY 2009 Accomplishments: In FY 2009: Improved power scaling and efficiency of fiber laser architectural improvements to meet emerging DoD and commerci						

Exhibit R-2A, RDT&E Project Just	ification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develop	& Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603605	-	-	Technology	<b>PROJECT</b> 633151: <i>La</i> <i>Integration</i>	sers and Ima	aging Develo	opment and
B. Accomplishments/Planned Pro	gram (\$ in M	lillions <u>)</u>									
							FY 2009	FY 2010			
FY 2010 Plans: In FY 2010: Conduct Congress Components.	sionally-direct	ed effort for	Advanced	Fiber Lasers S	Systems and	1					
				Congre	ssional Add	s Subtotals	0.957	5.418			
C. Other Program Funding Summa	arv (\$ in Mill	ions)									
		<b>/</b>	FY 2011	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	FY 2010	Base	000	Total	FY 2012	FY 2013	FY 2014	FY 2015	Complete	Total Cost
• PE 0602102F: <i>Materials.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603270F: <i>Electronic</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Combat Technology.											
• PE 0602605F: Directed Energy Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0601108F: <i>High Energy</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Laser Research Initiatives.											
• PE 0602890F: High Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Laser Research.											
• PE 0603924F: High Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Laser Advanced Technology											
Program.											
• PE 0602120A: Sensors and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Electronic Survivability.	0.000	0.000	0.000	0.000	0.000	0 000	0.000		0.000	0.000	0.000
• PE 0602307A: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Weapons Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0 000	0.000	0.000	0.000	0.000
• PE 0602624A: Weapons and Munitions Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603004A: Weapons and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Munitions Advanced Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: February 2010				
APPROPRIATION/BUDGET ACTIVI 3600: Research, Development, Test BA 3: Advanced Technology Develop		<b>R-1 ITEM NO</b> PE 0603605			- echnology	<b>PROJECT</b> 633151: Lasers and Imaging Development Integration							
C. Other Program Funding Summa	ry (\$ in Mill	ions)											
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>			
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost		
• PE 0602114N: Power Projection	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Applied Research.													
• PE 0603175C: Ballistic Missile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Defense Technology													
• PE 0603883C: Ballistic Missile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Defense Boost Phase Segment.													
• PE 0602651M-A: Joint Non-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Lethal Weapons Applied Research.													
• PE 0602651M-B: Joint Non-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Lethal Weapons Applied Research.													

### **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, RDT&E Project Just	tification: PE	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develo	& Evaluation	,		R-1 ITEM NOMENCLATURE         PROJECT           PE 0603605F: Advanced Weapons Technology         633152: High Power Microwave Data and Integration				crowave De	velopment		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	8.506	13.369	10.578	0.000	10.578	12.196	11.186	11.655	12.492	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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
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.	2.369	0.542	0.652	0.000	0.65
FY 2009 Accomplishments: In FY 2009: Continued to develop and evaluate technologies for Air Force non-lethal weapons applications. Continued development of first iteration full-power non-lethal test source for airborne/ long range configurations. Continued hardware development, procurement, fabrication, and testing for the full power source test stand for airborne/long range configurations. Provided technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and glean data relevant to airborne applications.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603605F: <i>Advanced Weapons</i>	Technology		<b>ROJECT</b> 3152: High Power Microwave Deve d Integration		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Continue to develop and evaluate technologies for A applications. Conduct engagement modeling and simulation supprequirements refinement and associated flowdown to technical sy analyze, and evaluate source and thermal subsystem options for Provide technical expertise and background to external organizat and capabilities to their needs and glean data relevant to airborne</li> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Continue to develop and evaluate technologies for A applications. Conduct additional engagement simulations suppor refinement. Begin prime power hardware development for next g technical expertise and background to external organizations tailor capabilities to their needs and glean data relevant to airborne applications.</li> </ul>	porting next generation system vstem requirements. Develop, next-generation non-lethal systems. ions tailoring Active Denial concepts applications. Arr Force non-lethal weapons ting next generation system eneration transmitters. Provide pring Active Denial concepts and					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
<ul> <li>MAJOR THRUST: Develop and evaluate HPM and other unconvention integration on various platforms, including aerial. Investigate specific <i>FY 2009 Accomplishments:</i></li> <li>In FY 2009: Conducted laboratory demonstration of the miniaturi electronics system. Increased the system performance and addressing issues. Enhanced HPM components for aerial demonstrator system and ruggedization. Enhanced command and control systems for testbed to determine the air breakdown threshold on new HPM are HPM source for next generation system.</li> </ul>	target sets of interest. zed and ruggedized HPM counter- essed electromagnetic interference em to increase system performance the HPM aerial demonstrator. Used	6.137	12.827	9.926	0.000	9.926

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603605F: <i>Advanced Weapons</i> 7	Technology	PROJECT 633152: Hig and Integra	gh Power Mic tion	crowave Dev	/elopment
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: As a part of CHAMP, integrate narrowband HPM concounter-electronics demonstrations. Conduct ground testing of Cl and environmental testing of the integrated system. Obtain flight of Conduct effects experiments using the CHAMP hardware includin assessment capability. Refine and implement HPM source compounforeseen issues in application systems. Fabricate next-generat candidate aerial platforms, implement in testbeds, and test operat funding in FY 2010 for the Counter-electronics HPM Advance Mis Capability Technology Demonstration.</li> <li>FY 2011 Base Plans:</li> <li>In FY 2011: Complete the integration of narrowband HPM compound testing of the champer and the guidance system accuracy, platform controllability for beam performance. Conduct an inert flight test with the guidance system accuracy, platform controllability for beam performance.</li> <li>FY 2011 OCO Plans:</li> <li>In FY 2011 OCO: N/A</li> </ul>	HAMP including effects testing certification of the CHAMP system. g evaluating battle damage onent technology to overcome tion compact HPM components for ion and performance. Increased sile Project (CHAMP) Joint ments into the CHAMP aerial cluding effects testing and vith the aerial platform to verify binting, and timing for triggering					
	ishments/Planned Programs Subtotals	8.506	13.369	10.578	0.000	10.578

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVI	ΤY			R-1 ITEM NO	OMENCLAT	URE		PROJECT			
3600: Research, Development, Test	& Evaluation	, Air Force		PE 0603605	F: Advanced	l Weapons 7	Fechnology	633152: <i>Hig</i>	h Power Mi	crowave De	velopment
BA 3: Advanced Technology Develop	oment (ATD)							and Integrat	ion		
C. Other Program Funding Summa	arv (\$ in Mill	ions)									
	<b>,</b> (+	<u></u>	FY 2011	FY 2011	FY 2011					Cost To	
Line Item	FY 2009	<u>FY 2010</u>	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	Complete	Total Cost
• PE 0602202F: Human Systems	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology.											
• PE 0602605F: Directed Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology.											
• PE 0602120A: Sensors and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Electronic Survivability.											
• PE 0602624A: Weapons and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Munitions Technology.											
• PE 0602114N: <i>Power Projection.</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602651M-C: Joint Non-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lethal Weapons Applied Research.											
• PE 0603851M: <i>Nonlethal</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Weapons.											

### **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, RDT&E Budget Item J	lustification	: PB 2011 A	ir Force						DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 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 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
Total Program Element	54.614	50.502	39.701	0.000	39.701	40.359	41.015	41.691	42.355	Continuing	Continuing	
635280: Manufacturing Technologies	50.876	46.528	37.701	0.000	37.701	39.359	41.015	41.691	42.355	0.000	0.000	
635281: Manufacturing Readiness	3.738	3.974	2.000	0.000	2.000	1.000	0.000	0.000	0.000	0.000	0.000	

### Note

Note: In FY 2009 the AF Manufacturing Technology (ManTech) program transfered 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, RDT&E Budget Item Justification: PB 2011 Air F	orce			DATE:	February 2010	)
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)		EM NOMENCLA 03680F: Manufa	<b>ATURE</b> cturing Technologies			
B. Program Change Summary (\$ in Millions)						
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	<u>FY 2011</u>	
Previous President's Budget	56.376	39.913	0.000	0.000		0.000
Current President's Budget Total Adjustments	54.614 -1.762	50.502 10.589	39.701 39.701	0.000 0.000		9.701 9.701
Congressional General Reductions	-1.702	0.000	39.701	0.000	5	9.701
Congressional Directed Reductions		0.000				
Congressional Rescissions	0.000	-0.211				
Congressional Adds		10.800				
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000				
Reprogrammings	0.000	0.000				
SBIR/STTR Transfer	0.000 -1.762	0.000 0.000	39.701	0.000	0	9.701
Other Adjustments	-1.702	0.000	39.701	0.000	5	9.701
Congressional Add Details (\$ in Millions, and Include	s General Red	<u>uctions)</u>			FY 2009	FY 2010
Project: 635280: Manufacturing Technologies						
Congressional Add: Advance Casting and Coating Te	echnologies for	Aircraft Canopies	S.	·	2.792	0.000
Congressional Add: Nano-Composite Structures Man	nufacturing Tecl	hnology Developi	ment.		0.798	0.000
Congressional Add: Next Generation Manufacturing	Process.				1.197	0.000
Congressional Add: Prepreg Thickness Variability Re	eduction Progra	т.			1.596	0.000
Congressional Add: Technology Insertion Demonstra	tion and Evalua	ation (TIDE).			3.191	0.000
Congressional Add: Laser Peening for Friction Stir W	/elded Aerospa	ce Structures.			1.596	1.593
Congressional Add: Next Generation Casting Initiativ	<i>'</i> e.				2.394	3.983
Congressional Add: Production of Nanocomposites f	or Aerospace A	pplications.			1.596	1.593
Congressional Add: Automated Processing of Advan	ced Low Obser	vables (RAPALO	)).		1.596	1.195
Congressional Add: Mobile Laser Systems for Aircra	ft Structures (M	LSAS).			0.000	0.797
Congressional Add: Wire Integrity Technology.					0.000	1.593

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	ATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Technologies</i>		
Congressional Add Details (\$ in Millions, and Includes Ge	eneral Reductions)	FY 2009	FY 2010
	Congressional Add Subtotals for Project: 6352	80 16.756	10.754
	Congressional Add Totals for all Project	ts 16.756	10.754
Change Summary Explanation			

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

In FY 2010, Congress added \$1.2 million for Automated Processing of Advanced Low Observables (RAPALO), \$1.6 million for Laser Peening for Friction Stir Welded Aerospace Structures, \$0.8 million for Mobile Laser Systems for Aircraft Structures (MLSAS), \$4.0 million for Next Generation Casting Initiative, \$1.6 million for Production of Nanocomposites for Aerospace Applications, and \$1.6 million for Wire Integrity Technology.

C. Performance Metrics Under Development.

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Exhibit R-2A, RDT&E Project Jus	stification: Pl	3 2011 Air F	orce						DATE: February 2010			
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 3: Advanced Technology Devel	st & Evaluatio		R-1 ITEM NOMENCLATURE PE 0603680F: Manufacturing TechnologiesPROJECT 635280: Manufacturing Technologies			Technologies	ologies					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
635280: Manufacturing Technologies	50.876	46.528	37.701	0.000	37.701	39.359	41.015	41.691	42.355	0.000	0.000	

#### <u>Note</u>

Note: In FY 2009, the AF Manufacturing Technologies program transfered 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

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### B. Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and implement cost-effective maintenance, repair, and manufacturing technologies for sustainment of Air Force weapon systems.	6.387	13.982	15.080	0.000	15.080
FY 2009 Accomplishments: In FY 2009: Continued cost-effective repair and manufacturing technologies for affordable sustainment of aircraft and turbine engine components. Continued Engine Rotor Life Extension technical effort to extend the life of critical, high value rotating engine components, which have been in service and scheduled for retirement. Continued assessments and manufacturing technology					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Techn</i>	ologies	<b>PROJECT</b> 635280: <i>Ma</i>	nufacturing	Technologie	s
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>development to reduce costs and lead times for high value supply rapid response productivity improvement efforts with selected high <i>FY 2010 Plans:</i></li> <li>In FY 2010: Continue cost-effective repair and manufacturing tech of both aircraft and turbine engine components. Continue assess development to reduce logistic support costs, lead times for high view cycle times for depot repair. Continue rapid response productivity high value programs.</li> <li><i>FY 2011 Base Plans:</i></li> <li>In FY 2011: Continue efforts for cost-effective repair and manufacturing affordable sustainment of aircraft and turbine engine components. manufacturing technology development to reduce logistics support</li> </ul>	n value programs. nologies for affordable sustainment ments and manufacturing technology value supply chain commodities, and improvement efforts with selected cturing technologies enabling . Continue assessments and t costs, lead times for high value					
supply chain commodities, and cycle times for depot repair. Conti improvement efforts with selected high value programs. Commen Maintenance concept at Air Logistics Centers to reduce Programm and cost. <i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A.	ce efforts supporting High Velocity					
MAJOR THRUST: Develop and transition pervasive affordability and p systems and processes.	roducibility technologies for weapon	27.733	21.792	22.621	0.000	22.621
FY 2009 Accomplishments: In FY 2009: Continued high value efforts to verify advantages of f military integration, quality processing, and supplier improvements manufacturing capabilities for more affordable low-observable stru	s. Continued development of					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Technolo</i>	ogies	<b>PROJECT</b> 635280: <i>Ma</i>	nufacturing	Technologie	s
3. Accomplishments/Planned Program (\$ in Millions)			1			
	I	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 201 <sup>2</sup> Total
<ul> <li>capabilities for advanced propulsion technologies. Continued improvement efforts for selected high value programs. Continuant and producibility. Continued efforts on Active Electronically Selected manufacturing processes for reduced costs and cycle continued efforts on affordable datalink components to enable for reduced costs and cycle times and increased production the on critical technologies in lab and acquisition programs to ensite transition.</li> <li><i>FY 2010 Plans:</i> <ul> <li>In FY 2010: Continue high value efforts to verify advantages of military integration, quality processing, and supplier improvem demonstration of manufacturing capabilities for more affordable manufacturing capabilities for advanced propulsion technologie productivity improvement efforts for selected high value prograe electronics manufacturing technologies for various C2ISR and affordability and producibility. Continue efforts on AESA radar processes for reduced costs and cycle times and greater prod radars. Continue efforts on affordable datalink components to processes for pervasive space needs. Conduct assessments acquisition programs to ensure affordable, producible technologies for yation programs to ensure affordable, producible technologies for pervasive space needs. Conduct assessments acquisition programs to ensure affordable, producible technologies for military integration, quality processing, and supplier improvem transition of manufacturing capabilities for more affordable between the processes for pervasive space needs. Conduct assessments acquisition programs to ensure affordable, producible technologies for pervasive space needs. Conduct assessments acquisition programs to ensure affordable, producible technologies for pervasive space needs. Conduct assessments acquisition programs to ensure affordable, producible technologies for pervasive space needs. Conduct assessments acquisition of manufacturing capabilities for more affordable low for the processing. And supplier improvem t</li></ul></li></ul>	ued efforts to address critical electronics ications in order to improve affordability canned Arrays (AESA) radar to enable e times and greater production capacity. improved manufacturing processes roughput. Conducted assessments ure affordable, producible technology of flexible manufacturing, commercial/ ents. Continue development and e low-observable structures. Develop es. Continue rapid response ams. Continue efforts to address critical space applications in order to improve to enable improved manufacturing uction capacity of next generation enable improved manufacturing relopment of advanced manufacturing on critical technologies in lab and ogy transition.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Techno</i>	ologies	<b>PROJECT</b> 635280: <i>M</i> a	anufacturing	Technologie	s
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>manufacturing capabilities for advanced propulsion technologies improvement efforts for selected high value programs. Continumanufacturing technologies for various C2ISR and space system and producibility. Continue efforts on AESA radar to enable impreduced costs and cycle times and greater production capacity efforts on affordable datalink components to enable advanced manufacturing processes to reduce costs and cycle times, as we development of advanced manufacturing processes for pervas Conduct assessments on critical technologies in lab and acquise producible technology transition.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A.</li> </ul>	ue efforts to address critical electronics ems in order to improve affordability proved manufacturing processes for of next generation radars. Continue technology insertion through improved well as system miniaturization. Continue sive space subsystems or components.					
Accor	mplishments/Planned Programs Subtotals	34.120	35.774	37.701	0.000	37.70
		FY 2009	FY 2010	1		
		2.792		_		
Congressional Add: Advance Casting and Coating Technologies for FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Adv Technologies for Aircraft Canopies.	·	2.192	0.000			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
Congressional Add: Nano-Composite Structures Manufacturing Te	echnology Development.	0.798	0.000			

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Techr</i>	nologies	<b>PROJECT</b> 635280: <i>Ma</i>	anufacturing Technologies
3. Accomplishments/Planned Program (\$ in Millions)	'		1	
		FY 2009	FY 2010	]
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Nar Technology Development.	no-Composite Structures Manufacturing			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Next Generation Manufacturing Process.		1.197	0.000	-
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Nex	t Generation Manufacturing Process.			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Prepreg Thickness Variability Reduction Progr	am.	1.596	0.000	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Pre Program.	preg Thickness Variability Reduction			
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.				
Congressional Add: Technology Insertion Demonstration and Evalu	uation (TIDE).	3.191	0.000	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Technologies</i>	<b>PROJECT</b> 635280: <i>M</i>	anufacturing Technologies
B. Accomplishments/Planned Program (\$ in Millions)	1	1	
	FY 200	9 FY 2010	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Teo Evaluation (TIDE).	chnology Insertion Demonstration and		
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.			
Congressional Add: Laser Peening for Friction Stir Welded Aerosp	1.5 bace Structures.	96 1.593	3
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Las Aerospace Structures.	ser Peening for Friction Stir Welded		
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Laser Aerospace Structures.	Peening for Friction Stir Welded		
	2.3	94 3.983	3
Congressional Add: Next Generation Casting Initiative.			
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Ne Initiative.	xt Generation Casting Supplier Base		
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Next Initiative.	Generation Casting Supplier Base		
Congressional Add: Production of Nanocomposites for Aerospace	Applications.	96 1.593	3

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			1	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Techr</i>	nologies	<b>PROJECT</b> 635280: <i>M</i> a	anufacturing Technologies
3. Accomplishments/Planned Program (\$ in Millions)	· · · ·		1	
		FY 2009	FY 2010	
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for Pro Aerospace Applications.	duction of Nanocomposites for			
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Produc Applications.	ction of Nanocomposites for Aerospace			
Congressional Add: Automated Processing of Advanced Low Obse	PAPAI (A)	1.596	1.195	-
FY 2009 Accomplishments: In FY 2009: Conducted Congressionally-directed effort for RAF				
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for RAPA	LO.			
Congressional Add: Mobile Laser Systems for Aircraft Structures (N FY 2009 Accomplishments: In FY 2009: Not Applicable.	MLSAS).	0.000	0.797	
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Mobile (MLSAS).	e Laser Systems for Aircraft Structures			
Congressional Add: Wire Integrity Technology.		0.000	1.593	

Exhibit R-2A, RDT&E Project Ju	ustification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET AC 3600: Research, Development, To BA 3: Advanced Technology Deve	est & Evaluation	, Air Force		<b>R-1 ITEM N</b> PE 0603680	-	-	ologies	<b>PROJECT</b> 635280: <i>Ma</i>	anufacturing	Technologie	es
B. Accomplishments/Planned F	Program (\$ in M	lillions)									
							FY 2009	FY 2010	]		
FY 2009 Accomplishments: In FY 2009: Not Applicable.											
<i>FY 2010 Plans:</i> In FY 2010: Conduct Congr	essionally-direct	ed effort for	Wire Integri	ty Technolog	у.						
				Congre	essional Add	s Subtotals	16.756	10.754	-		
C. Other Program Funding Sum	nmarv (\$ in Mill	ions)						<u>.</u>	<u>_</u>		
	2 .	·	<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item • PE 0708011F: Industrial Preparedness	<u>FY 2009</u> 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	<u>0C0</u> 0.000	<u>Total</u> 0.000	<u>FY 2012</u> 0.000	<u>FY 2013</u> 0.000		<u>FY 2015</u> 0.000	<u>Complete</u> 0.000	
D. Acquisition Strategy All major contracts in this Progra	am Element wer	e awarded a	after full and	open compe	tition.						
<b>E. Performance Metrics</b> Please refer to the Performance Force performance goals and m					Air Force r	esources are	e applied an	d how those	resources a	re contributi	ng to Air

Exhibit R-2A, RDT&E Project Just							DATE: February 2010					
	RIATION/BUDGET ACTIVITY earch, Development, Test & Evaluation, Air Force anced Technology Development (ATD)				<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Technologies</i>				<b>PROJECT</b> 635281: <i>Manufacturing Readiness</i>			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
635281: Manufacturing Readiness	3.738	3.974	2.000	0.000	2.000	1.000	0.000	0.000	0.000	0.000	0.000	

#### <u>Note</u>

Note: In FY 2009, the AF Manufacturing Technologies program transfered 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
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.	3.738	3.974	2.000	0.000	2.000
FY 2009 Accomplishments: In FY 2009: Developed Manufacturing Maturation Plans (MMPs) for all Category I ATDs and selected high-visibility program based on MRA. Selected MMPs were executed to increase the MRL and improve technology transition to production. Conducted MRAs on selected Air Force acquisition programs to aid in Milestone Decision Reviews and/or to mitigate cost, schedule, or rate issues. Manufacturing risk was documented based on the assessments and was delivered to the appropriate					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603680F: <i>Manufacturing Techno</i>	ologies	<b>PROJECT</b> 635281: <i>Manufacturing Readiness</i>					
3. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>program offices. Pervasive manufacturing issues discovered of through the ManTech requirements process.</li> <li><i>FY 2010 Plans:</i> <ul> <li>In FY 2010: Continue development of Manufacturing Maturatia and selected high-visibility programs based on MRA. Execute and improve technology transition to production. Conduct MR programs to aid in Milestone Decision Reviews and/or to mitig. Document manufacturing risk based on the assessments and offices. Vet pervasive manufacturing issues discovered during requirements process.</li> </ul> </li> <li><i>FY 2011 Base Plans:</i> <ul> <li>In FY 2011: Continue development of Manufacturing Maturatia and selected high-visibility programs based on MRAs. Execute and improve technology transition to production. Conduct MR programs to aid in Milestone Decision Reviews and/or to mitig. Document manufacturing risk based on the assessments and programs to aid in Milestone Decision Reviews and/or to mitig. Document manufacturing risk based on the assessments and programs to aid in Milestone Decision Reviews and/or to mitig. Document manufacturing risk based on the assessments and program offices. Vet pervasive manufacturing issues discover ManTech requirements process.</li> </ul> </li> <li><i>FY 2011 OCO Plans:</i> <ul> <li>In FY2011 OCO Plans:</li> <li>In FY2011 OCO: N/A.</li> </ul> </li> </ul>	on Plans (MMPs) for Category I ATDs selected MMPs to increase the MRL As on selected Air Force acquisition ate cost, schedule, or rate issues. deliver to the appropriate program g the assessments through the ManTech on Plans (MMPs) for Category I ATDs e selected MMPs to increase the MRL As on selected Air Force acquisition ate cost, schedule, or rate issues. deliver results to the appropriate							
		3.738	3.974	2.000	0.000	<u> </u>		

Exhibit R-2A, RDT&E Project Justi	fication: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)R-1 ITEM NOMENCLATURE PE 0603680F: Manufacturing TechnologiesPROJECT 635281: Manufacturing Readiness											
C. Other Program Funding Summa	ary (\$ in Milli	ions)	FY 2011	FY 2011	FY 2011					Cost To	
<u>Line Item</u> • PE Not Provided (11524): <i>PE,</i> 0708011F, Industrial Preparedness	FY 2009 0.000	<b>FY 2010</b> 0.000	<b>Base</b> 0.000	0.000	<u>Total</u> 0.000	FY 2012 0.000	FY 2013 0.000	FY 2014 0.000	FY 2015 0.000		<u>Total Cost</u> 0.000

### 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, RDT&E Budget Item	Justification	: PB 2011 A	ir Force						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information Dev/Demo</i>							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	0.000	46.414	32.382	0.000	32.382	39.295	44.272	46.913	48.504	Continuing	Continuing
635319: Anticipatory OPS Intent and Response	0.000	10.569	8.031	0.000	8.031	8.889	9.912	8.648	6.354	Continuing	Continuing
635320: Assured Worldwide Connectivity	0.000	18.572	8.216	0.000	8.216	12.076	13.064	17.965	22.253	Continuing	Continuing
635321: Global Battlespace Awareness	0.000	9.829	9.318	0.000	9.318	10.676	10.800	13.351	12.403	Continuing	Continuing
635322: Knowledge Management and Computing	0.000	7.444	6.817	0.000	6.817	7.654	10.496	6.949	7.494	Continuing	Continuing

#### <u>Note</u>

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 imager). 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 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,

	Air Force			DATE	: February 2010	)
APPROPRIATION/BUDGET ACTIVITY	R	-1 ITEM NOMENCLA	TURE			
3600: Research, Development, Test & Evaluation, Air Force	e Pi	E 0603788F: <i>Global</i> .	Information Dev/Demo			
BA 3: Advanced Technology Development (ATD)						
utilization, and management of information in the enterpris and execution with the accuracy, fidelity, and timeliness n						
for dynamic decision making to create, plan, and execute		•			•	•
domain - air, space, or cyber. This program is in Budget A				ops and demonstrate	s technologies f	for existing
upgrades and/or new system developments that have mili	itary utility and a	ddress warfighter ne	eds.			
B. Program Change Summary (\$ in Millions)						
	<u>FY 200</u>	<u>9 FY 2010</u>	FY 2011 Base	FY 2011 OCO	<u>FY 2011</u>	Total
Previous President's Budget	0.00		0.000	0.000		0.000
Current President's Budget	0.00		32.382	0.000		2.382
Total Adjustments	0.00		32.382	0.000	3	2.382
<ul> <li>Congressional General Reductions</li> </ul>		0.000				
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000				
<ul> <li>Congressional Rescissions</li> </ul>	0.00					
<ul> <li>Congressional Adds</li> </ul>		6.900				
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000				
<ul> <li>Reprogrammings</li> </ul>	0.00					
SBIR/STTR Transfer	0.00					
Other Adjustments	0.00	0 0.000	32.382	0.000	3	2.382
	ludes General I	Reductions)			FY 2009	FY 2010
Congressional Add Details (\$ in Millions, and Inc		(caucions)				
Congressional Add Details (\$ in Millions, and Inc Project: 635320: Assured Worldwide Connectivity		<u>inconcerns</u>				
			tion Exchange.		0.000	3.983
Project: 635320: Assured Worldwide Connectivity	nterconnects for		tion Exchange.			3.983 2.888
<b>Project:</b> 635320: <i>Assured Worldwide Connectivity</i> Congressional Add: <i>Massively Parallel Optical I</i>	nterconnects for	Battlespace Informa	<i>tion Exchange.</i> gressional Add Subtotal:	s for Project: 635320	0.000	

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	
3600: Research, Development, Test & Evaluation, Air Force	PE 0603788F: Global Information Dev/Demo	
BA 3: Advanced Technology Development (ATD)		

### **Change Summary Explanation**

Note: In FY 2010, Congress added \$4.0 million for Cyber Attack and Security Environment and \$2.9 million for MPOI for Battlespace Information Exchange. The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

C. Performance Metrics

Under Development.

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Exhibit R-2A, RDT&E Project Just	tification: PE	3 2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)					PE 0603788F: Global Information Dev/Demo				PROJECT 335319: Anticipatory OPS Intent and Response		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	10.569	8.031	0.000	8.031	8.889	9.912	8.648	6.354	Continuing	Continuing

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate distributed information technologies that are scalable and reconfigurable and provide seamless access to tailored multi-media and multi-spectral data.	0.000	1.694	1.446	0.000	1.446
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
FY 2010 Plans: 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.					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information De</i>	ev/Demo	<b>PROJECT</b> 635319: Ar Response	nticipatory OF	PS Intent and	1
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Continue campaign of experimentation to quantitatively measu control concepts enabled by net centric warfare capabilities. In Command and Control (C2) planning and scheduling technolog operations. Start the development of an integrated C2 tasking spectrum options to be reasoned over and recommendations p commander's intent. Develop capability to generate a user-det space, and cyber domains at the strategic, operational, and tac <i>FY 2011 Base Plans:</i> In FY 2011: Complete development of capabilities to allow sea situational awareness and understanding by the decision make an initial capability to plan and measure effectiveness of inform precision munitions to determine successful achievement of co Continue campaign of experimentation to quantitatively measu control concepts enabled by net centric warfare capabilities. C planning and scheduling technologies to enable enhanced spa of an integrated C2 tasking capability to enable seamless full s and recommendations provide to the operator that will meet co development of the capability to integrate a variety of user-defi to visualize individual data set contexts for better situational aw cyber domains at the strategic, operational, and tactical levels. capability to conduct space C2.	itiate an investigation of space gies to enable enhanced space capability to enable seamless full rovided to the operator that will meet ined operational picture across the air, stical levels. amless information sharing for enhanced er. Continue the development of ation operations synchronized with mmand intent in time and location. re transformational command and ontinue the investigation of space C2 ce operations. Continue development pectrum options to be reasoned over mmander's intent. Complete the ned operating display technologies vareness across the air, space and					
MAJOR THRUST: Develop and demonstrate the integration of plan intelligent agents for adaptive preplanning and decision support too	•	0.000	4.432	3.007	0.000	3.007

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information Dev</i>	//Demo	<b>PROJECT</b> 635319: An Response	ticipatory Ol	PS Intent and	d
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2009 Accomplishments: In FY 2010: Not Applicable.</li> <li>FY 2010 Plans:</li> <li>In FY 2010: Continue development of capabilities to be more agi environment. Continue development of timely option generation, capabilities that account for uncertainty and missing and erroneod decision making processes. Continue to develop dynamic workfl capabilities to manage the command and control enterprise. Initi assess adverse events that could potentially impact air and space courses of action (COAs) that could be initiated to continue operations evaluate mobility COAs covering planning through assessment the and provides prioritized feasible recommendations that meets conto to assess the impact of cyber on air and space C2 operations and continue operations in the face of cyber threats.</li> <li>FY 2011 Base Plans: In FY 2011: Continue development of timely option generation a capabilities to manage the command and control enterprise. Conto decision making processes. Continue to develop dynamic workfl capabilities to manage the command and control enterprise. Conto to assess adverse events that could potentially impact air and space COAs that could be initiated to continue operations. Continue the mobility COAs covering planning through assessment that anticip provides prioritized feasible recommendations that meets command of capability to assess the impact of cyber on air and space C2 operations of capability to assess the impact of cyber on air and space C2 operations.</li> </ul>	selection, and coordination us information and supports intuitive ow and workload management ate development of a capability to a mobility operations and suggest itions. Investigate methods to nat anticipates multiple constraints mmander's intent. Develop capability d suggest COAs to be initiated to le within a net centric enabled selection and coordination us information, and supports intuitive ow and workload management nplete development of a capability ace mobility operations and suggest e investigation of methods to evaluate ates multiple constraints and nder's intent. Continue development					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information De</i>	ev/Demo	<b>PROJECT</b> 635319: An Response	ticipatory OF	PS Intent and	1
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop and demonstrate an effects-based approac and assessment techniques that enable decision makers to determine of		0.000	4.443	3.578	0.000	3.578
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Initiate the development and demonstrate real-time inf a decision maker to comprehend his or her current situational awar progress against desired effects (reflective) and identifying key indi anticipating future success or failure of a campaign (predictive). Co to enable a decision support environment that enables the decision aspects of the future battlespace. Continue development of predict the ability to reason over models of the "enemy as a system." Eval analysis of cascading effects in real-time for diverse courses of act for rapidly wargaming proposed actions against an intelligent adver capability to enable integrated traditional and cyber effects based a operations centers. Develop capability to integrate kinetic and non- tasking order to achieve desired commander's effects.	reness by assessing an operation's cators and observables to assist in ontinue investigating the methods maker to anticipate and shape all tive battlespace planning tools with uate competing approaches for the ion. Initiate design of a tool suite rsary. Develop and demonstrate assessment for air and space					
FY 2011 Base Plans: In FY 2011: Continue the development and demonstration of real-t that enable a decision maker to comprehend their current situational operation's progress against desired effects (reflective) and identify to assist in anticipating future success or failure of a campaign (pre and evaluating methods to enable a decision support environment	al awareness by assessing an ving key indicators and observables dictive). Complete investigating					

Exhibit R-2A, RDT&E Project Ju	stification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACT 3600: Research, Development, Te BA 3: Advanced Technology Deve	st & Evaluation	, Air Force		<b>R-1 ITEM N</b> PE 0603788	-	-	ev/Demo	<b>PROJECT</b> 635319: An Response	9: Anticipatory OPS Intent and		
B. Accomplishments/Planned P	rogram (\$ in M	illions)									
		·					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
to anticipate and shape all as battlespace planning tools wi Demonstrate a suite of intera effects of proposed actions in	th the ability to cting tools/serv	reason over ices that ass	models of th ist analysts	ne "enemy as	s a system."						
FY 2011 OCO Plans: In FY 2011 OCO: N/A											
			Accomplish	ments/Plann	ed Program	s Subtotals	0.000	10.569	8.031	0.000	8.03
C. Other Program Funding Sum Line Item • PE Not Provided (11746): Activity Not Provided	mary (\$ in Mill <u>FY 2009</u> 0.000	ions) FY 2010 0.000	FY 2011 Base 0.000	FY 2011 OCO 0.000	<u>FY 2011</u> <u>Total</u> 0.000	<u>FY 2012</u> 0.000	<b>FY 2013</b> 0.000	<u>FY 2014</u> 0.000	<b>FY 2015</b> 0.000	<u>Cost To</u> <u>Complete</u> 0.000	<u>Total Cos</u> 0.00
<ul> <li><u>D. Acquisition Strategy</u></li> <li>Not applicable.</li> <li>E. Performance Metrics</li> </ul>				ation on how			applied an	d how those	resources a	re contributi	na to Air

Exhibit R-2A, RDT&E Project Ju	stification: Pl	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)								<b>PROJECT</b> 635320: <i>As</i>	PROJECT 635320: Assured Worldwide Connectivity		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
635320: Assured Worldwide Connectivity	0.000	18.572	8.216	0.000	8.216	12.076	13.064	17.965	22.253	Continuing	Continuing

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate secure wideband assured networking between weapon platforms, ground facilities, and Special Operations teams.	0.000	1.426	0.313	0.000	0.313
FY 2009 Accomplishments: In FY 2009: Not Applicable.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information D</i>	ev/Demo	<b>PROJECT</b> 635320: <i>Assured Worldwide</i> C			ctivity
B. Accomplishments/Planned Program (\$ in Millions)	,		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Continue development of small form-factor networkin design and demonstration of soldier interface, perform initial flight						
FY 2011 Base Plans: In FY 2011: Complete development of small form-factor networkir	ng and reachback capability.					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Proactively defend cyberspace through cyber situat defeating cyber threats, and surviving through adaptation and self-generation and		0.000	4.270	3.333	0.000	3.333
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Demonstrate a fleet of 1,000 cooperative, positively of defend mission critical information system assets and collect action awareness. Continue assured end-to-end Quality of Service (QoS integration to the information system enterprise during malicious a capability to geo-locate red, blue, and non-combatant IP addresse achieve better situational awareness to efficiently position cyber do complete situational awareness capability of cyber network assets both virtual and physical cyber assets.	nable CybINT for cyber situation 6) and Quality of Assurance (QoA) nd non-malicious faults. Develop s and devices globally and locally to efenses. Initiate development of a					
FY 2011 Base Plans: In FY 2011: Continue development of a comprehensive situational capability of cyber network assets, both red and blue forces, to inc						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information D</i>	Dev/Demo	<b>PROJECT</b> 635320: <i>As</i>	wide Connec	de Connectivity	
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>assets. Continue assured end-to-end QoA and QoA integration during malicious and non-malicious faults. Develop capability network topologies to enhance cyber situation assessment an mission essential functions. Initiate the development of technologies adversary to strengthen the quality of threat assessments. Init voice-over-IP (VOIP) capability to enhance the utility of voice the environment. Develop cyber testbed capability for in-house in and offensive cyber techniques with the ability to conform to communing and rules of engagement.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	to automatically discover large-scale d map the discovered topologies to ologies that provides knowledge of the tiate the development of a cross-domain transmissions within a mobile tactical vestigations of cyber defense policies					
MAJOR THRUST: Develop and demonstrate offensive cyber oper Experimental Cyber Craft technology demonstrations.	rations capabilities in a series of	0.000	3.321	2.492	0.000	2.49
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Continue to analyze development of additional of integrated kinetic and cyber operations planning and execution control (Cyber C2) operations functions. Complete selected o remain stealthy, gather intelligence, and affect adversary infor Finalize technology demonstration plans.	n capabilities, and cyber command and ffensive cyber capabilities to access,					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010					
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information D</i>	<b>PROJECT</b> 635320: As	<b>ROJECT</b> 35320: <i>Assured Worldwide Connectivity</i>				
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 Base Plans: In FY 2011: Continue to analyze development of additional off integrated kinetic and cyber operations planning and execution functions.							
<i>FY 2011 OCO Plans:</i> FY 2011 OCO: Not Applicable.							
MAJOR THRUST: Develop and demonstrate intelligent networking to provide assured, seamless, battlespace connectivity to the Air Fe		0.000	0.230	0.828	0.000	0.828	
<i>FY 2009 Accomplishments:</i> In FY 2009: Not Applicable.							
FY 2010 Plans: In FY 2010: Initiate advanced demonstration of high capacity a communications for global spectrum dominance. Develop Qos dissemination combined with network policy language for effici	S-enabled information management and						
FY 2011 Base Plans: In FY 2011: Continue to develop advanced demonstration of h communications for global spectrum dominance. Continue dev management and dissemination combined with network policy information exchange in airborne networks.	velopment of QoS-enabled information						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A							
MAJOR THRUST: Integrate and demonstrate a resilient and self- dynamically recognizes, characterizes, and understands novel cybe		0.000	1.171	0.574	0.000	0.574	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information D</i>					- ssured Worldwide Connectivity			
B. Accomplishments/Planned Program (\$ in Millions)									
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total			
FY 2009 Accomplishments: In FY 2009: Not Applicable.									
FY 2010 Plans: In FY 2010: Begin integration of technologies to introduce sy systems. Initiate integration of anti-tamper software protectio systems.									
FY 2011 Base Plans: In FY 2011: Continue integration technologies to recognize, of and anomalies, aid in the creation of synthetically diverse, fur continuously monitor, reconfigure, and self optimize.									
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A									
MAJOR THRUST: Integrate technology to demonstrate an effects defense that focuses on avoiding, deferring, and minimizing the th		0.000	0.000	0.676	0.000	0.676			
FY 2009 Accomplishments: In FY 2009: Not Applicable.									
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.									
FY 2011 Base Plans: In FY 2011: Develop technologies to simulate a diverse set of by transferring the attack to specialized nodes for analysis. In									

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information De</i>	T Assured Worldwide Connectivity				
B. Accomplishments/Planned Program (\$ in Millions)	l		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
to automatically generate secure system/network configuration specifications, and operational requirements.	n based on policy, architectural					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop and demonstrate flight ready systems frequency (RF) and optical components and architectures for next	0.000	1.283	0.000	0.000	0.00	
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Complete the design of higher throughput RF wa adverse weather conditions. Begin fabrication of several flight systems.						
FY 2011 Base Plans: In FY 2011: Effort moves to 0602788F, Project 5315.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
Acco	mplishments/Planned Programs Subtotals	0.000	11.701	8.216	0.000	8.21
		FY 2009	FY 2010	]		
		0.000		-		
Congressional Add: Massively Parallel Optical Interconnects for B	attlespace Information Exchange.					

Exhibit R-2A, RDT&E Project J	ustification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET AC 3600: Research, Development, 7 BA 3: Advanced Technology Dev	est & Evaluation	, Air Force		<b>R-1 ITEM N</b> PE 0603788			ev/Demo	<b>PROJECT</b> 635320: <i>As</i>	CT Assured Worldwide Connectivity		
B. Accomplishments/Planned	Program (\$ in M	lillions)									
·	•						FY 2009	FY 2010	]		
FY 2009 Accomplishments: In FY 2009: Not Applicable											
FY 2010 Plans: In FY 2010: Conduct Cong Battlespace Information Exc		ed effort for	Massively F	arallel Optic	al Interconne	ects for					
							0.000	2.888			
Congressional Add: Cyber Attac	ck and Security E	Environment.									
FY 2009 Accomplishments: In FY 2009: Not Applicable FY 2010 Plans: In FY 2010: Conduct Cong		ed effort for	Cyber Attac	k and Securi	ty Environm	ent.					
				Congre	ssional Add	s Subtotals	0.000	6.871			
C. Other Program Funding Sur	nmary (\$ in Mill	ions <u>)</u>	FY 2011	FY 2011	FY 2011				,	Cost To	
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	Complete	Total Cos
• PE Not Provided (12059): Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
D. Acquisition Strategy Not applicable.											
E. Performance Metrics Please refer to the Performance Force performance goals and n					Air Force re	esources are	e applied an	d how those	resources a	re contributi	ng to Air

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force							DATE: February 2010				
	ATION/BUDGET ACTIVITY       R-1 ITEM NOMENCLATURE       PROJECT         rch, Development, Test & Evaluation, Air Force       PE 0603788F: Global Information Dev/Demo       635321: Global Battlespace Awareness         ced Technology Development (ATD)       PE 0603788F: Global Information Dev/Demo       635321: Global Battlespace Awareness								ess		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
635321: Global Battlespace Awareness	0.000	9.829	9.318	0.000	9.318	10.676	10.800	13.351	12.403	Continuing	Continuing

#### <u>Note</u>

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 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Demonstrate advanced signal and data exploitation technologies for detection, tracking, identification, and targeting of time-critical targets, and information extraction.	0.000	2.961	3.400	0.000	3.400
FY 2009 Accomplishments: In FY 2009: Not Applicable.					
FY 2010 Plans: 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					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information De</i>	ev/Demo	<b>PROJECT</b> 635321: <i>Global Battlespace Awaren</i>			
3. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 201 Total
<ul> <li>products (e.g., named areas, target areas, COA, units, infrastrul Initiate development of techniques for analyzing and assessing assessment. Complete demonstration of integrated intelligence produce anticipatory ground to space awareness picture. Come exploitation tools to enable characterization and assessment or signal processing developments to a range of progressive RF to communications systems and radar. Initiate research and demactive distributed sensing and processing and identify the limitation include detection, discrimination, location, tracking, and targetil Intercept enemy threats.</li> <li><i>FY 2011 Base Plans:</i></li> <li>In FY 2011: Continue development of a set of algorithms that a dynamically update various sub-sets of the existing intelligence products (e.g., named areas, target areas, COA, units, infrastrut Continue development of techniques for analyzing and assession assessment. Complete development of methodologies and proform a collection of ever present stand-in multi-sensor sensor at to overcome the limitations previously identified. Finish develop frequency (to name a few available degrees of freedom) diverse exploit the new added degrees of freedom (spatial) to combat I path, multi-waveform diverse environments, low probability of threats). Initiate the development of a set of algorithms that ca support of Space Situational Awareness (SSA). Initiate develop techniques to fit into existing Intelligence, Surveillance, and Refer 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	activities to support situation e data and analysis products to uplete development of multi-sensor f adversary satellites. Expand previous threats and hardware including nonstrate the performance gains with ations for further research. Missions ing of advanced Low Probability of can automatically develop, reason, e preparation of the battlespace ucture areas, lines of communication). ing activities to support situation becessing of collecting intelligence data ad-hoc networks. Develop technologies pment of spatial, temporal, and e signal processing methods that harsh RF environments (including multi- intercept threats, and short on time n automatically track space objects in pment to enhance signal processing					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information De</i>	ev/Demo	<b>PROJECT</b> 635321: <i>Gl</i> d	PROJECT 635321: Global Battlespace Awareness		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate advanced data hand distributed data fusion to enable a more effective utilization of data		0.000	0.643	1.667	0.000	1.667
FY 2009 Accomplishments: FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Finalize evaluation and support toolsets for advance community accepted measures of performance across all effor a variety of user definable display technologies to visualize ind situational awareness.	rts. Develop capability to integrate					
FY 2011 Base Plans: In FY 2011: Initiate development to mature and integrate more provide support for situation analysis utilizing a service oriente adaptively optimize the use of the received data. Develop and distributed fusion to enhance situational awareness of the batt robust support applications to enhance multi-intelligence colle	ed architecture. Develop techniques to d demonstrate the capability to conduct tlespace. Develop and demonstrate					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop and demonstrate capabilities for reaso link and group discovery, and advanced analysis for situational aw		0.000	2.206	1.515	0.000	1.515
FY 2009 Accomplishments: FY 2009: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information De</i>	ev/Demo	<b>PROJECT</b> 635321: <i>Gl</i>	obal Battlesp	ace Awaren	ess
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul> <li>FY 2010 Plans: In FY 2010: Initiate development of a text extraction capability t extractor, based on their specialized knowledge of the domain, t Initiate development of techniques for abnormality detection in e different types to find unusual circumstances. Initiate developm behavioral modeling techniques and advanced capabilities for a understanding, situation monitoring, and event anticipation.</li> <li>FY 2011 Base Plans: In FY 2011: Continue development of a text extraction capabilit the extractor, based on their specialized knowledge of the doma Continue development of tools and services for advanced behavioral advanced capabilities for analysis that integrate situation understevent anticipation.</li> </ul>	o achieve higher performance. evidence of connections and paths of ent of tools and services for advanced nalysis that integrate situation y that enables users to fine-tune in, to achieve higher performance. vioral modeling techniques and					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Develop models to provide detailed understandir future strategy in order to identify adversary COAs, and determine th <i>FY 2009 Accomplishments:</i> FY 2009: Not Applicable.		0.000	3.376	2.130	0.000	2.130
FY 2010 Plans: In FY 2010: Continue research to forecast actionable futures to to appraise and plan the "best" blue COA for Rapid, Decide, Act investigation of ability to forecast potential adversaries and ever evidence and projected known and/or anticipated threat(s). Initi	and Adapt (RDAA). Continue its based on indications of known					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information D</i>	ev/Demo	<b>PROJECT</b> 635321: <i>Gl</i>	CT Global Battlespace Awareness		
B. Accomplishments/Planned Program (\$ in Millions)	1		1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
manage multiple possible future adversary COAs prioritized ba impact/threat. Initiate investigation in developing screening te maker insight into the contribution or sensitivity of various factor Initiate investigation of techniques that will allow model adapta	chniques that give the analyst/decision or					
FY 2011 Base Plans: In FY 2011: Complete research to forecast actionable futures to appraise and plan the "best" blue course of action for RDAA forecast potential adversaries and events based on indications known and/or anticipated threat(s). Continue investigating the future adversary COAs prioritized based on current and future investigation in developing screening techniques that give the the contribution or sensitivity of various factors on a given obsi to model and explore policy actions and reactions taken by the development of a functional graphical user environment to sup investigation of techniques that will allow model adaptation to	A. Complete investigation of ability to s of known evidence and projected capability to manage multiple possible (projected) impact/threat. Continue analyst/decision maker insight into ervable/response. Initiate capability e different modeled entities. Initiate oport output analysis. Complete					
FY 2011 OCO Plans: In FY 2011 OCO: N/A						
MAJOR THRUST: Develop and demonstrate the mechanisms req authenticating data codes and executables for trusted/optimized co		0.000	0.643	0.606	0.000	0.606
FY 2009 Accomplishments: FY 2009: Not Applicable.						
FY 2010 Plans: In FY 2010: Initiate the application of developed watermarking programs of record, targeting intelligence applications. Integra						

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Exhibit R-2A, RDT&E Project Justi	ification: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develop	& Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603788	-	-		<b>PROJECT</b> 635321: <i>Gl</i> d	obal Battlesp	ace Awarer	ess
B. Accomplishments/Planned Prog	gram (\$ in M	illions)					1				
-		·					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
into a development program, pr development of protocols for the information assurance scenario	e application					•					
FY 2011 Base Plans: In FY 2011: Continue integration Work toward integration of tech providing information provenance FY 2011 OCO Plans:	nologies into	network-cei	ntric program	ns of record f	or the purpo						
In FY 2011 OCO: N/A			A 11-1			0.14.4.1	0.000	0.000	0.040	0.000	0.04
			Accomplish	ments/Plann	ed Program	s Subtotals	0.000	9.829	9.318	0.000	9.31
C. Other Program Funding Summa	ary (\$ in Milli	ons)	FY 2011	FY 2011	FY 2011					Cost To	
Line Item • PE Not Provided (12252): Activity Not Provided	<u>FY 2009</u> 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	<u>OCO</u> 0.000	<u>Total</u> 0.000	<u>FY 2012</u> 0.000	<u>FY 2013</u> 0.000	<u>FY 2014</u> 0.000	<u>FY 2015</u> 0.000	<u>Complete</u> 0.000	<u>Total Cos</u> 0.00
<b>D. Acquisition Strategy</b> 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, RDT&E Project Just	tification: PE	3 2011 Air F	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET ACTIV 3600: Research, Development, Test BA 3: Advanced Technology Develo	t & Evaluatio			R-1 ITEM NOMENCLATURE         PROJECT           PE 0603788F: Global Information Dev/Demo         635322: Knowledge Management Computing				nagement a	nd		
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	7.444	6.817	0.000	6.817	7.654	10.496	6.949	7.494	Continuing	Continuing

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate computer architectures with greater capacity and sophistication to enable game changing computing power to the warfighter, anywhere, anytime.	0.000	0.491	1.259	0.000	1.259
FY 2009 Accomplishments: In FY 2009: Not Applicable.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information L</i>	Dev/Demo	PROJECT 635322: Kr Computing	5322: Knowledge Management and				
B. Accomplishments/Planned Program (\$ in Millions)								
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
FY 2010 Plans: In FY 2010: Initiate development of petaflops embedded on-de for on-board processing of common sensor algorithms. Compl for autonomous systems. Initiate development of a stacked ch autonomous systems. Develop scalable stacked chip architect system for cognitive and autonomous systems.	ete design of a fungible node ip architecture for cognitive and							
FY 2011 Base Plans: In FY 2011: Continue the development of petaflops embedded achieved performance and functionality. Continue developmen cognitive and autonomous systems. Demonstrate performance payoff high performance computing applications to reduce size	nt of stacked chip architecture for e. Develop and demonstrate high-							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A								
MAJOR THRUST: Demonstrate how a publish, subscribe, and que can enable vertical and horizontal integration of Air Force information		0.000	5.354	3.138	0.000	3.138		
FY 2009 Accomplishments: In FY 2009: Not Applicable.								
FY 2010 Plans: In FY 2010: Develop secure, accreditable services to assist in more independent security domains while preventing information Develop a single multi-level repository which can securely store security levels but can be accessed from multiple security dom consolidation and reduce the duplicate information storage with common security labeling methodology that promotes the autor	on disclosure to untrustworthy users. e information containing multiple ains. This capability will promote IT nin each security domain. Develop a							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information Dev</i>	ı/Demo	PROJECT 635322: Kn Computing	5322: Knowledge Management and				
3. Accomplishments/Planned Program (\$ in Millions)			1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
<ul> <li>among different security domains. Provide for security labeling information access policies. Develop approaches for applying mobile ad-hoc networks which are often characterized by low-Initiate development of a method to securely link data and me adaptive security policy expression and enforcement mechanic release among different security domains. Develop and perfor sharing mechanisms in an operational setting to support a produce content-based dissemination mechanisms. Beg systems based implementation of distributed mission operation aware information management technologies to enable the ravirtual and constructive entities and systems. Develop and decollect, correlate, and analyze multi-source threat data across operators determine minimum impact of detected threat event <i>FY 2011 Base Plans:</i></li> <li>In FY 2011: Continue to develop secure, accreditable cross of Initiate an effort to develop a scalable integrated environment securely shared across multiple secure domains while preven disclosure. Initiate development of a framework for integrating development. Continue development of an adaptive security mechanism for automated information review and release among development of the demonstration of the methodology require information from a higher classification domain to a lower class partners as part of a scalable cross domain information management information management for an adaptive security information from a higher classification domain to a lower class partners as part of a scalable cross domain information management for 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	g secure information sharing concepts to bandwidth and intermittent connectivity. tadata. Initiate development of an sm for automated information review and rm field demonstrations of cross domain ototype installation command system. in development of a mature open- ins infrastructure that leverages context- pid incorporation and interaction of live, emonstrate capability to intelligently multiple security domains to assist cyber rs.							

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information De</i>	ev/Demo	PROJECT 635322: Kr Computing	owledge Ma	nagement ar	nd
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Demonstrate expertise in applied math and algor architectures including multi-tiered memory hierarchies, and multi-co		0.000	0.445	0.820	0.000	0.820
FY 2009 Accomplishments: In FY 2009: Not Applicable.						
<ul> <li>FY 2010 Plans:</li> <li>In FY 2010: Initiate rapid reaction identifying and optimizing cod improvement through the techniques applied. Initiate predictabl exploiting mechanisms in emerging technology to ease the com software in embedded and software-intensive systems and enal of provably correct systems and guaranteed interoperability pro- systems.</li> </ul>	e software testing. Create tools for plexity, understanding, and managing bling rapid construction/modernization					
FY 2011 Base Plans: In FY 2011: Continue predictable software testing by creating to emerging technology to ease the complexity, understanding, an software-intensive systems and enabling rapid construction/mod and guaranteed interoperability providing trusted components an real-time high performance computing services to enhance space	d managing software in embedded and lernization of provably correct systems nd systems. Develop and demonstrate					
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: N/A						
MAJOR THRUST: Demonstrate how agile information management sharing in a tactical environment.	services enable effective information	0.000	1.154	1.600	0.000	1.600
FY 2009 Accomplishments: In FY 2009: Not Applicable.						

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603788F: <i>Global Information De</i>	ev/Demo	PROJECT 635322: Kri Computing	Knowledge Management and			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<ul> <li>FY 2010 Plans: In FY 2010: Develop and demonstrate pub/sub/query mechansuch as Global Hawk and Joint STARS. These tactical sharin operational concepts of employment and the ability to perform</li> <li>FY 2011 Base Plans: In FY 2011: Initiate development of tactical information mana focusing on stability, performance, and reliability. Establish misolation from malicious client applications, assured levels of case where all resources are not locally controlled. Develop t similar to conventional service oriented architectures but oper disruptions. Initiate development of tactical information dominaerial systems, "wide-body" assets and high-altitude platforms capability to integrate a variety of common operating display t set contexts for better situational awareness across the air, spoperational, and tactical levels.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: N/A</li> </ul>	g mechanisms will be evaluated against the operational objectives. gement pub/sub/query mechanisms echanisms for assured access and guality of service, and in some cases best actical service approaches that appear ate and compensate for airborne based ance capabilities that include unmanned s. Complete the development of the echnologies to visualize individual data						
	mplishments/Planned Programs Subtotals	0.000	7.444	6.817	0.000	6.81	

Exhibit R-2A, RDT&E Project J	ustification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET AC 3600: Research, Development, 7 BA 3: Advanced Technology Dev	est & Evaluation	, Air Force		<b>R-1 ITEM NO</b> PE 0603788			ev/Demo	PROJECT 635322: Kno Computing	owledge Ma	nagement a	nd
C. Other Program Funding Sun	nmary (\$ in Mill	ons)	EV 2044	EV 2044	EV 2014					Coot To	
Line Item	FY 2009	FY 2010	<u>FY 2011</u> Base	<u>FY 2011</u> OCO	<u>FY 2011</u> Total	FY 2012	FY 2013	FY 2014	FY 2015	<u>Cost To</u>	Total Cost
• PE Not Provided (12415): Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.000
<b>D. Acquisition Strategy</b> Not applicable.											
E. Performance Metrics					A' E						

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, RDT&E Budget Item	Justification	: PB 2011 A	ir Force						DATE: Feb	ruary 2010	
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 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	32.986	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
634072: Dominant Battlespace Awareness	8.102	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
634216: Battlespace Information Exchange	14.345	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
634872: Aerospace Information Dominance	10.539	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### <u>Note</u>

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, RDT&E Budget Item Justification: PB 2011 Air F	orce			DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force 3A 3: Advanced Technology Development (ATD)		F <b>EM NOMENCLA</b> 603789F: <i>C3I Ad</i> v	ATURE vanced Development					
3. Program Change Summary (\$ in Millions)								
	FY 2009	<u>FY 2010</u>	FY 2011 Base	FY 2011 OCO	FY 2011 Total			
Previous President's Budget	33.902	0.000	0.000	0.000	0.000			
Current President's Budget	32.986	0.000	0.000	0.000	0.000			
Total Adjustments	-0.916	0.000	0.000	0.000	0.000			
<ul> <li>Congressional General Reductions</li> </ul>		0.000						
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000						
<ul> <li>Congressional Rescissions</li> </ul>	0.000	0.000						
Congressional Adds		0.000						
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000						
Reprogrammings	0.000	0.000						
SBIR/STTR Transfer	0.000	0.000						
Other Adjustments	-0.916	0.000	0.000	0.000	0.000			

#### **Change Summary Explanation**

Note: In FY 2010, Congress added \$4.0 million for Cyber Attack and Security Environment and \$2.9 million for MPOI for Battlespace Information Exchange. These efforts were transfered to PE 0603788F, Global Information Dominance, via Form 1414. The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner. C. Performance Metrics

Under Development.

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Exhibit R-2A, RDT&E Project Jus	Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force										
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)					IOMENCLA 9F: <i>C3I Adva</i>		opment	<b>PROJECT</b> 634072: <i>Dominant Battlespace Awareness</i>			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
634072: Dominant Battlespace Awareness	8.102	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

#### <u>Note</u>

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 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate advanced signal and data exploitation technologies for detection, tracking, identification, and targeting of time-critical targets.	2.215	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Demonstrated a real-time signal processing and geolocation capability for emerging commercial communications used by military and asymmetrical threats. Demonstrated airborne-cued ground-based signal processing. Developed multi-sensor exploitation tools to enable characterization and assessment of adversary satellites. Integrated intelligence data and analysis products to produce anticipatory ground to space awareness picture.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603789F: <i>C3I Advanced Develop</i>	oment	<b>PROJECT</b> 634072: <i>D</i> o	ominant Battle	espace Awa	reness
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
FY 2011 Base Plans: In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.						
<ul> <li>MAJOR THRUST: Develop and demonstrate advanced data han distributed data fusion to enable a more effective utilization of the <i>FY 2009 Accomplishments:</i></li> <li>In FY 2009: Demonstrated software and algorithmic design a of adversarial behavior within persistent surveillance data, co tracking, multi-INT association and cross-cueing and geospat Demonstrated methods for combining post-event processing Intel data for indications and warning functions. Designed an environment for the evaluation of the full range of fusion tech algorithms to higher levels of fusion algorithms tested in conju Fusion of CYBINT with traditional INTs. Developed the capa unstructured text in order to enable automated visualization of <i>FY 2010 Plans:</i></li> <li>In FY 2010: Not Applicable.</li> </ul>	data available. and development efforts for determination ntextual tracking, target-feature-aided tial reasoning and cued exploitation. of Intel data with real time streaming id developed a synthetic assessment nologies to include basic correlation unction with C2 systems. Investigated bility to extract events of interest form	5.887	0.000	0.000	0.000	0.000
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						

Exhibit R-2A, RDT&E Project Jus	stification: PB	2011 Air Fo	rce						DATE: February 2010			
APPROPRIATION/BUDGET ACTI 3600: Research, Development, Tes BA 3: Advanced Technology Devel	Development, Test & Evaluation, Air ForcePE 0603789F: C3I Advanced Development634072Technology Development (ATD)634072						<b>PROJECT</b> 634072: <i>Do</i>	CT Dominant Battlespace Awareness				
B. Accomplishments/Planned Pr	ogram (\$ in M	illions)										
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applica	ble.											
			Accomplish	nments/Plann	ed Program	s Subtotals	8.102	0.000	0.000	0.000	0.000	
C. Other Program Funding Sumr	nary (\$ in Milli	ions)										
	2 .	·	<u>FY 2011</u>	FY 2011	FY 2011					<u>Cost To</u>		
Line Item	FY 2009	<u>FY 2010</u>	<b>Base</b>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<b>Complete</b>	Total Cost	
• PE Not Provided (12597): Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
• PE 0602702F: Command,	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Control, and Communications. • PE 0603203F: Advanced Aerospace Sensors.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

## 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-2A, RDT&E Project Justification: PB 2011 Air Force										DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)					IOMENCLA 9F: <i>C3I Adva</i>	TURE anced Devel	opment	<b>PROJECT</b> 634216: <i>Battlespace Information Exchange</i>					
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost		
634216: Battlespace Information Exchange	14.345	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing		

#### <u>Note</u>

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate secure wideband assured networking between weapon platforms, ground facilities and Special Operations teams.	1.087	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Developed small form-factor networking and reachback capability. Began certification of the capability in preparation for transition to the Special Operations Forces.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603789F: <i>C3I Advanced Deve</i>	elopment	<b>PROJECT</b> 634216: <i>Ba</i>	attlespace Information Exchange			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.							
MAJOR THRUST: Proactively defend cyberspace through cyber s defeating cyber threats, and surviving through adaptation and self-		2.599	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Developed technology demonstration plans for a reconnaissance defense on wired networks. Conducted cybe Developed secure data sharing to prevent the disclosure of se users.	r situational awareness demonstration.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.							
MAJOR THRUST: Design, develop, demonstrate, test, and validation and simulating the Air Force's extension of the Global Information	•	1.318	0.000	0.000	0.000	0.000	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603789F: <i>C3I Advanced Devel</i>	lopment	<b>PROJECT</b> 634216: <i>Ba</i>	attlespace Information Exchange				
B. Accomplishments/Planned Program (\$ in Millions)			.1					
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total		
FY 2009 Accomplishments: In FY 2009: Conducted the validation of the enhanced model support tool suite and make it usable by an operational persor the limitations of the modeling capability and applied the mode environments.	n instead of programmers. Exercised							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.								
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.								
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.								
MAJOR THRUST: Design, develop, and demonstrate the enterpri paper policy and translate that into network policy.	ise management capability to accept on-	0.991	0.000	0.000	0.000	0.00		
FY 2009 Accomplishments: In FY 2009: Developed and demonstrated reconfiguration of strategic, tactical, and network events (e.g., changes in inform condition (THREATCON), defense condition (DEFCON), mali	nation condition (INFOCON), threat							
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.								
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.								

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603789F: <i>C3I Advanced Devel</i>	opment	<b>PROJECT</b> 634216: <i>Ba</i>	<b>PROJECT</b> 634216: <i>Battlespace Information Exc</i>		
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 OCO Plans: In FY 2011 OCO: Not Applicable.						
MAJOR THRUST: Develop and demonstrate offensive cyber oper experimental cyber craft technology demonstrations.	ations capabilities in a series of	2.042	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Analyzed development of selected offensive cybe kinetic and cyber operations planning and execution capabilitie (Cyber C2) operations functions.						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
FY 2011 OCO Plans: In FY 2011 OCO: Not Applicable.						
MAJOR THRUST/CONGRESSIONAL ADD: Develop and demons management technology to provide assured, seamless battlespace		6.308	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Completed improvements in the battle manageme communications networked collaborative capability by demons in a coalition and multi-service environment, enabling aircraft to surveillance, and reconnaissance airborne and ground inform investigation to provide assured access (anti-jam) covert high	strating Air Force airborne networking, o access each other's intelligence, ation environments. Conducted					

Exhibit R-2A, RDT&E Project J	ustification: PB	2011 Air Fo	orce						DATE: Feb	ruary 2010	
APPROPRIATION/BUDGET AC 3600: Research, Development, 7 BA 3: Advanced Technology Dev	Test & Evaluation	, Air Force		<b>R-1 ITEM N</b> PE 0603789			opment	<b>PROJECT</b> 634216: <i>Ba</i>	ttlespace Ini	formation Ex	change
B. Accomplishments/Planned	Program (\$ in M	lillions)									
		<b>r</b>					FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
networking, while denying th Massively Parallel Optical Ir					directed effo	rt for					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable											
FY 2011 Base Plans: In FY 2011: Not Applicable											
FY 2011 OCO Plans: In FY 2011 OCO: Not Appli	cable.										
			Accomplish	ments/Plann	ed Program	s Subtotals	14.345	0.000	0.000	0.000	0.000
C. Other Program Funding Sur	nmary (\$ in Mill	ions)									
Line Item	FY 2009	FY 2010	<u>FY 2011</u> Base	<u>FY 2011</u> OCO	<u>FY 2011</u> Total	FY 2012	FY 2013	FY 2014	FY 2015	<u>Cost To</u> Complete	
• PE Not Provided (12844): Activity Not Provided	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000	
<b>D. Acquisition Strategy</b> Not Applicable.											
E. Performance Metrics Please refer to the Performance	e Base Budget C	overview Boo	ok for inform	ation on how	Air Force re	esources are	e applied an	nd how those	resources a	ire contributi	ng to Air

Exhibit R-2A, RDT&E Project Jus	tification: PE	3 2011 Air F	orce						DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>R-1 ITEM NOMENCLATURE</b> PE 0603789F: <i>C3I Advanced Development</i>				<b>PROJECT</b> 634872: Aerospace Information Dominance				
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost	
634872: Aerospace Information Dominance	10.539	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing	

#### <u>Note</u>

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 and demonstrate, 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 and 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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop and demonstrate distributed information technologies that are scalable and reconfigurable and provide seamless access to tailored multi-media and multi-spectral data.	1.453	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Initiated the development of capabilities to allow seamless information sharing for enhanced situational awareness and understanding by the decision maker. developed an					

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PROJEC1         634872: A         FY 2010	Verospace Info FY 2011	FY 2011 OCO	ninance FY 2011 Total
) FY 2010	-		-
FY 2010	-		-
2 0.000	0 0.000	0.000	0.000
6	62 0.00	62 0.000 0.000	62 0.000 0.000 0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603789F: <i>C3I Advanced Devel</i>	lopment	<b>PROJECT</b> 634872: <i>Ae</i>	rospace Info	ormation Dor	ninance
B. Accomplishments/Planned Program (\$ in Millions)			1			
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
workflow and workload management capabilities to manage th resources.	ne command and control constellation of					
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.						
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.						
MAJOR THRUST: Demonstrate an effects-based approach for the assessment techniques that enable decision makers to determine		3.153	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Demonstrated technology to meet the needs for e operational environment. Designed, developed, and demonst effects-based assessment in a dynamic tasking environment. up-to-date awareness on whether the execution of the battle p Investigated the methods to enable a decision support environ to anticipate and shape all aspects of the future battlespace. In battlespace awareness tools with the ability to reason over mo Conducted analysis of cascading effects in real-time for diverse research to forecast actionable futures to support a decision m the "best" blue course of action for RDAA. Conducted investig adversaries and events based on indications of known eviden anticipated threat(s).] Initiated assured end-to-end Quality of s integration to the information system enterprise during malicio	rated the capabilities for continuous Demonstrated techniques to accomplish olan is meeting the desired effects. Initiated development of predictive odels of the "enemy as a system." See courses of action. [Conducted maker's ability to appraise and plan gation of ability to forecast potential ce and projected known and/or Service and Quality of Assurance					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Febr	uary 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603789F: <i>C3I Advanced Deve</i>	lopment	<b>PROJECT</b> 634872: <i>Ae</i>	erospace Information Dominance			
B. Accomplishments/Planned Program (\$ in Millions)			1				
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
FY 2011 OCO Plans: In FY 2011 OCO: Not Applicable.							
MAJOR THRUST: Develop and demonstrate high performance co limited applications, and emulate older computing components.	mputing for size, weight, and power-	1.033	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2009: Completed development of high performance con limited applications. Supported the resulting hardware and so development of reliably autonomic small platforms for unmann hardware and system/support software that enables complex	ftware transition to the users. Initiated ned operations. Initiated analysis of						
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.							
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.							
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicable.							
MAJOR THRUST: Demonstrate how a publish, subscribe, and qu can enable vertical and horizontal integration of Air Force networks		4.238	0.000	0.000	0.000	0.000	

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force				DATE: Feb	ruary 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603789F: <i>C3I Advanced Develo</i>	opment	<b>PROJECT</b> 634872: Aerospace Information Dominand						
B. Accomplishments/Planned Program (\$ in Millions)			1						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total			
<ul> <li>FY 2009 Accomplishments: In FY 2009: Developed and demonstrated technologies that er dissemination across multiple security level boundaries. Initiate technology to assess, evaluate, and convert unstructured inforr Demonstrated capability integrating tactical and edge user infor Developed information transformation services and adaptive int learn, self-configure, self-manage, and are self-healing. Condu on demand that will exploit dynamic information services match phones, etc.) with appropriate information formats. Supported interfaces and semantic interoperability.</li> <li>FY 2010 Plans: In FY 2010 Plans: In FY 2011: Not Applicable.</li> <li>FY 2011 Base Plans: In FY 2011: Not Applicable.</li> <li>FY 2011 OCO Plans: In FY 2011 OCO: Not Applicable.</li> </ul>	ed the study of discovery and filter nation into structured information feeds. mation management requirements. formation management services that cted study on collaboration services ing end user devices (laptops, cell								
	plishments/Planned Programs Subtotals	10.539	0.000	0.000	0.000	0.000			

Exhibit R-2A, RDT&E Project J	ustification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)								<b>PROJECT</b> 634872: <i>Ae</i>	<b>JECT</b> 72: Aerospace Information Dominance			
C. Other Program Funding Sun	nmary (\$ in Mill	ions)										
			<u>FY 2011</u>	<u>FY 2011</u>	FY 2011					Cost To		
Line Item • PE Not Provided (13037): Activity Not Provided	<u>FY 2009</u> 0.000	<u>FY 2010</u> 0.000	<u>Base</u> 0.000	<u>OCO</u> 0.000	<u>Total</u> 0.000	<u>FY 2012</u> 0.000	<u>FY 2013</u> 0.000	<u>FY 2014</u> 0.000	<u>FY 2015</u> 0.000	<u>Complete</u> 0.000	<u>Total Cost</u> 0.000	
<b>D. Acquisition Strategy</b> Not Applicable.												
E. Performance Metrics	e Base Budget (	werview Boo	k for inform	ation on how			applied an	d how those	resources a	re contributi	na to Air	

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, RDT&E Budget Item	Justification	i: PB 2011 A	ir Force						DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>R-1 ITEM NOMENCLATURE</b> PE 0603924F: <i>High Energy Laser Advanced Technology Program</i>							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	3.899	3.794	1.847	0.000	1.847	1.122	1.237	1.569	2.382	Continuing	Continuing
635095: High Energy Laser Advanced Technology Program	3.899	3.794	1.847	0.000	1.847	1.122	1.237	1.569	2.382	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 2009	<u>FY 2010</u>	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	4.002	3.831	0.000	0.000	0.000
Current President's Budget	3.899	3.794	1.847	0.000	1.847
Total Adjustments	-0.103	-0.037	1.847	0.000	1.847
<ul> <li>Congressional General Reductions</li> </ul>		-0.021			
<ul> <li>Congressional Directed Reductions</li> </ul>		0.000			
<ul> <li>Congressional Rescissions</li> </ul>	0.000	-0.016			
Congressional Adds		0.000			
<ul> <li>Congressional Directed Transfers</li> </ul>		0.000			
Reprogrammings	0.000	0.000			
SBIR/STTR Transfer	0.000	0.000			
Other Adjustments	-0.103	0.000	1.847	0.000	1.847

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)	<b>R-1 ITEM NOMENCLATURE</b> PE 0603924F: <i>High Energy Laser Advanced Technology Pro</i>	ogram

#### **Change Summary Explanation**

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

C. Performance Metrics Under Development.

Exhibit R-2A, RDT&E Project Just	tification: PE	3 2011 Air F	orce						DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 3: Advanced Technology Development (ATD)				<b>R-1 ITEM NOMENCLATURE</b> PE 0603924F: <i>High Energy Laser Advanced</i> <i>Technology Program</i>				<b>PROJECT</b> 635095: High Energy Laser Advanced Technology Program			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total 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	3.899	3.794	1.847	0.000	1.847	1.122	1.237	1.569	2.382	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. Accomplishments/Planned Program (\$ in Millions)**

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Advance solid state laser development. Develop beam-control technologies for surface and air mission areas.	3.899	3.794	1.847	0.000	1.847
FY 2009 Accomplishments: In FY 2009: Under the Joint High Power Solid State Laser (JHPSSL) project, completed the integration of modules for the 100 kilowatt project and demonstrated performance in a laboratory environment.					
FY 2010 Plans: In FY 2010: Initiate a joint high-power beam director development effort, suitable for mating with a JHPSSL device.					

Exhibit R-2A, RDT&E Project Just	tification: PB	2011 Air Fc	orce						DATE: Feb	ruary 2010		
APPROPRIATION/BUDGET ACTIVITYR-1 ITEM NOMENCLATURE3600: Research, Development, Test & Evaluation, Air ForcePE 0603924F: High Energy Laser AdvancedBA 3: Advanced Technology Development (ATD)Technology Program								<b>PROJECT</b> 635095: High Energy Laser Advanced Technology Program				
<b>B. Accomplishments/Planned Pro</b>	ogram (\$ in M	lillions)										
							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
FY 2011 Base Plans: FY 2011: Integrate a joint high system tests in a field environn		director, wit	th a JHPSSL	-like device.	Conduct in	tegrated						
<i>FY 2011 OCO Plans:</i> In FY 2011 OCO: Not Applicab	le.											
MAJOR THRUST: Develop and ev integration on various platforms, inc					•	cluding	0.000	0.000	0.000	0.000	0.000	
FY 2009 Accomplishments: In FY 2011 OCO: N/A												
<i>FY 2010 Plans:</i> In FY 2010: Not Applicable.												
<i>FY 2011 Base Plans:</i> In FY 2011: Not Applicable.												
FY 2011 OCO Plans: In FY 2011 OCO: Not Applicab	le.											
			Accomplish	ments/Plann	ed Program	s Subtotals	3.899	3.794	1.847	0.000	1.847	
C. Other Program Funding Summ	arv (\$ in Mill	ions)						·				
	ναι <b>γ</b> (ψ τη τητητη		FY 2011	FY 2011	FY 2011					Cost To		
Line Item	<u>FY 2009</u>	<u>FY 2010</u>	Base	000	Total	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	Complete	Total Cost	
• PE 0602890F: <i>High Energy</i> Laser Research.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Exhibit R-2A, RDT&E Project Justi	ification: PB	2011 Air Fo	rce						DATE: Feb	ruary 2010	
3600: Research, Development, Test & Evaluation, Air Force				<b>R-1 ITEM NOMENCLATURE</b> PE 0603924F: <i>High Energy Laser Advanced</i> <i>Technology Program</i>				<b>PROJECT</b> 635095: High Energy Laser Advanced Technology Program			
C. Other Program Funding Summa											
			<u>FY 2011</u>	<u>FY 2011</u>	<u>FY 2011</u>					<u>Cost To</u>	
Line Item	FY 2009	<u>FY 2010</u>	<u>Base</u>	000	<u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Complete</u>	Total Cost
• PE 0603444F: Maui Space											
Surveillance System.											
• PE 0603605F: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Weapons Technology.											
• PE 0601108F: High Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Laser Research Initiatives.											
• PE 0603883C: Ballistic Missile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Defense Boost Phase Segment.			0 000								
• PE 0602605F: Directed Energy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology. • PE 0602307A: Advanced	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Weapons Technology.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602114N: Power Projection	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Applied Research.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602120A: Sensors and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Electronic Survivability.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603004A: Weapons and	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Munitions Advanced Technology.											
• PE 0602702E: <i>Tactical</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technology.											
• PE 0603175C: Ballistic Missile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Defense Technology.											
• PE 0602651M: Joint Non-Lethal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Weapons Applied Research.											
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Jus						DATE: Feb	ruary 2010				
APPROPRIATION/BUDGET ACTI 6600: Research, Development, Tes 3A 3: Advanced Technology Devel	R-1 ITEM N PE 0603924 Technology	F: High Ene		<b>PROJECT</b> 635095: High Energy Laser Advanced Technology Program							
C. Other Program Funding Sumn	nary (\$ in Milli	ions)									
Line Item • PE 0603651M: Joint Non- Lethal Weapons Technology	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u> <u>Base</u>	<u>FY 2011</u> <u>OCO</u>	<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Cost To</u> Complete	
Development. D. Acquisition Strategy Not Applicable.											
E. Performance Metrics Please refer to the Performance E Force performance goals and mo					Air Force r	esources are	e applied ar	id how those	resources a	re contributi	ng to Air