Department of Defense
Fiscal Year (FY) 2014 President's Budget Submission

April 2013

Air Force

Justification Book Volume 1 of 3

Research, Development, Test & Evaluation, Air Force

Vol-
I

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April 2013

INTRODUCTION AND EXPLANATION OF CONTENTS

1. (U) GENERAL

A. This document has been prepared to provide information on the United States Air Force (USAF) Research, Development, Test and Evaluation (RDT&E) program elements and projects in the FY 2014 President's Budget (PB).

1) All exhibits in this document have been assembled in accordance with DoD 7000.14R, Financial Management Regulation, Volume 2B, Chapter 5, Section 050402. Exception:

a) Exhibit R-1, RDT&E Program, which was distributed under a separate cover due to classification.

2) Other comments on exhibit contents in this document:

a) Exhibits R-2/2a and R-3 provide narrative information for all RDT&E program elements and projects within the USAF FY 2014 RDT&E program with the exception of classified program elements. The format sand contents of this document are in accordance to the guidelines and requirements of the Congressional committees in so far as possible.

b) The "Other Program Funding Summary portion of the R-2 includes, in addition to RDTE& funds, Procurement funds and quantities, Military Construction appropriation funds on specific development programs, Operations and Maintenance appropriation funds where they are essential to the development effort described, and where appropriate, Department of Energy (DOE) costs.

2. (U) CLASSIFICATION

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

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Department of Defense
FY 2014 President's Budget
Exhibit R-1 FY 2014 President's Budget
Total Obligational Authority
(Dollars in Thousands)

28 Mar 2013

Appropriation	FY 2012 (Base & OCO)	FY 2013 Base Request with CR Adj*	FY 2013 OCO Request with CR Adj*	Emergency Disaster Relief Act of 2013	FY 2013 Total Request with CR Adj*	FY 2014 Base
Research, Development, Test & Eval, AF	26,630,843	26,642,260	53,150		26,695,410	25,702,946
Total Research, Development, Test & Evaluation	26,630,843	26,642,260	53,150		26,695,410	25,702,946

R-1C: FY 2014 President's Budget (Published Version), as of March 28, 2013 at 10:18:35
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Department of Defense
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Summary Recap of Budget Activities	FY 2012 (Base & OCO)	FY 2013 Base Request with CR Adj*	FY 2013 OCO Request with CR Adj*	Emergency Disaster Relief Act of 2013	FY 2013 Total Request with CR Adj*	FY 2014 Base
Basic Research	493,609	516,034			516,034	524,770
Applied Research	1,235,584	1,109,053			1,109,053	1,127,893
Advanced Technology Development	662,751	596,737			596,737	617,526
Advanced Component Development & Prototypes	1,494,043	1,181,177			1,181,177	876,709
System Development & Demonstration	3,706,414	4,966,724			4,966,724	5,078,715
Management Support	1,697,349	1,190,349			1,190,349	1,179,791
Operational Systems Development	17,341,093	15,867,972			15,921,122	16,297,542
Undistributed		1,214,214			1,214,214	
Total Research, Development, Test & Evaluation	26,630,843	26,642,260			26,695,410	25,702,946

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Summary Recap of FYDP Programs						
Strategic Forces	440,383	222,582			222,582	254,061
General Purpose Forces	1,882,333	1,820,202			1,820,202	1,825,912
Intelligence and Communications	2,248,279	1,916,639			1,916,639	1,611,731
Mobility Forces	269,125	244,314			244,314	295,056
Research and Development	9,508,419	9,750,681			9,750,681	9,553,906
Central Supply and Maintenance	136,436	179,795			179,795	136,415
Training Medical and Other	1,895	1,760			1,760	1,727
Administration and Associated Activities	94,329	1,330,253			1,330,253	145,825
Support of Other Nations	3,798	3,851			3,851	3,785
Classified Programs	12,045,846	11,172,183	53,150		11,225,333	11,874,528
Total Research, Development, Test & Evaluation	26,630,843	26,642,260	53,150		26,695,410	25,702,946

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

Line No	Program Element Number	Item	Act	FY 2012 (Base & OCO)	FY 2013 Base Request with CR Adj*	FY 2013 OCO Request with CR Adj*	Emergency Disaster Relief Act of 2013	FY 2013 Total Request with CR Adj*	FY 2014 Base	Sec
1	0601102F	Defense Research Sciences	01	347,833	361,787			361,787	373,151	U
2	0601103F	University Research Initiatives	01	131,957	141,153			141,153	138,333	U
3	0601108F	High Energy Laser Research Initiatives	01	13,819	13,094			13,094	13,286	U
	Basic Research			493,609	516,034			516,034	524,770	
4	0602102F	Materials	02	142,417	114,166			114,166	116,846	U
5	0602201F	Aerospace Vehicle Technologies	02	145,392	120,719			120,719	119,672	U
6	0602202F	Human Effectiveness Applied Research	02	93,034	89,319			89,319	89,483	U
7	0602203F	Aerospace Propulsion	02	207,768	232,547			232,547	197,546	U
8	0602204F	Aerospace Sensors	02	136,327	127,637			127,637	127,539	U
9	0602601F	Space Technology	02	117,986	98,375			98,375	104,063	U
10	0602602F	Conventional Munitions	02	60,725	77,175			77,175	81,521	U
11	0602605F	Directed Energy Technology	02	139,769	106,196			106,196	112,845	U
12	0602788F	Dominant Information Sciences and Methods	02	139,980	104,362			104,362	138,161	U
13	0602890F	High Energy Laser Research	02	52,186	38,557			38,557	40,217	U
	Applied Research			1,235,584	1,109,053			1,109,053	1,127,893	
14	0603112F	Advanced Materials for Weapon Systems	03	60,626	47,890			47,890	39,572	U
15	0603199F	Sustainment Science and Technology (S&T)	03	5,618	6,565			6,565	12,800	U
16	0603203F	Advanced Aerospace Sensors	03	119,227	37,657			37,657	30,579	U
17	0603211F	Aerospace Technology Dev/Demo	03	64,544	81,376			81,376	77,347	U
18	0603216F	Aerospace Propulsion and Power Technology	03	115,725	151,152			151,152	149,321	U

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19	0603270F	Electronic Combat Technology	03	21,896	32,941			32,941	49,128	U
20	0603401F	Advanced Spacecraft Technology	03	70,643	64,557			64,557	68,071	U
21	0603444F	Maui Space Surveillance System (MSSS)	03	13,313	29,256			29,256	26,299	U
22	0603456F	Human Effectiveness Advanced Technology Development	03	24,082	21,523			21,523	20,967	U
23	0603601F	Conventional Weapons Technology	03	44,057	36,352			36,352	33,996	U
24	0603605F	Advanced Weapons Technology	03	45,823	19,004			19,004	19,000	U
25	0603680F	Manufacturing Technology Program	03	39,165	37,045			37,045	41,353	U
26	0603788F	Battlespace Knowledge Development and Demonstration	03	36,944	31,419			31,419	49,093	U
27	0603924F	High Energy Laser Advanced Technology Program	03	1,088						U
		Advanced Technology Development		662,751	596,737			596,737	617,526	
28	0603260F	Intelligence Advanced Development	04	4,013	3,866			3,866	3,983	U
29	0603287F	Physical Security Equipment	04	476	3,704			3,704	3,874	U
30	0603430F	Advanced EHF MILSATCOM (SPACE)	04	385,013	229,171			229,171		U
31	0603432F	Polar MILSATCOM (SPACE)	04	103,098	120,676			120,676		U
32	0603438F	Space Control Technology	04	43,553	25,144			25,144	27,024	U
33	0603742F	Combat Identification Technology	04	37,039	32,243			32,243	15,899	U
34	0603790F	NATO Research and Development	04	4,424	4,507			4,507	4,568	U
35	0603791F	International Space Cooperative R&D	04	615	652			652	379	U
36	0603830F	Space Protection Program (SPP)	04	7,074	10,429			10,429	28,764	U

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37	0603850F	Integrated Broadcast Service - Dem/Val	04	19,442	19,938			19,938		U
38	0603851F	Intercontinental Ballistic Missile - Dem/Val	04	71,824	71,181			71,181	86,737	U
39	0603854F	Wideband Global SATCOM RDT&E (Space)	04	12,077	12,027			12,027		U
40	0603859F	Pollution Prevention - Dem/Val	04	2,300	2,054			2,054	953	U
41	0603860F	Joint Precision Approach and Landing Systems - Dem/Val	04	7,076	57,975			57,975		U
42	0604015F	Long Range Strike	04	289,573	291,742			291,742	379,437	U
43	0604283F	Battle Mgmt Com & Ctrl Sensor Development	04	30,362	114,417			114,417		U
44	0604317F	Technology Transfer	04	2,474	2,576			2,576	2,606	U
45	0604327F	Hard and Deeply Buried Target Defeat System (HDBTDS) Program	04	120,838	16,711			16,711	103	U
46	0604330F	Joint Dual Role Air Dominance Missile	04	28,871						U
47	0604337F	Requirements Analysis and Maturation	04	22,794	16,343			16,343	16,018	U
48	0604422F	Weather System Follow-on	04	123,681	2,000			2,000		U
49	0604458F	Air & Space Ops Center	04						58,861	U
50	0604618F	Joint Direct Attack Munition	04						2,500	U
51	0604635F	Ground Attack Weapons Fuze Development	04	23,729	9,423			9,423	21,175	U
52	0604857F	Operationally Responsive Space	04	108,014						U
53	0604858F	Tech Transition Program	04	2,683	37,558			37,558	13,636	U
54	0105921F	Service Support to STRATCOM - Space Activities	04						2,799	U
55	0207455F	Three Dimensional Long-Range Radar (3DELRR)	04						70,160	U

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56	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	04		96,840			96,840	137,233	U
57	0305178F	National Polar-Orbiting Operational Environmental Satellite System (NPOESS)	04	43,000						U
		Advanced Component Development & Prototypes		1,494,043	1,181,177			1,181,177	876,709	
58	0603260F	Intelligence Advanced Development	05						977	U
59	0603840F	Global Broadcast Service (GBS)	05	5,631	14,652			14,652		U
60	0604222F	Nuclear Weapons Support	05	22,170	25,713			25,713		U
61	0604233F	Specialized Undergraduate Flight Training	05	19,725	6,583			6,583	3,601	U
62	0604270F	Electronic Warfare Development	05	16,397	1,975			1,975	1,971	U
63	0604280F	Joint Tactical Radio	05		2,594			2,594		U
64	0604281F	Tactical Data Networks Enterprise	05	45,104	24,534			24,534	51,456	U
65	0604287F	Physical Security Equipment	05	51	51			51	50	U
66	0604329F	Small Diameter Bomb (SDB) - EMD	05	133,902	143,000			143,000	115,000	U
67	0604421F	Counterspace Systems	05	28,946	28,797			28,797	23,930	U
68	0604425F	Space Situation Awareness Systems	05	216,212	267,252			267,252	400,258	U
69	0604429F	Airborne Electronic Attack	05	31,821	4,118			4,118	4,575	U
70	0604441F	Space Based Infrared System (SBIRS) High EMD	05	621,629	448,594			448,594	352,532	U
71	0604602F	Armament/Ordnance Development	05	7,755	9,951			9,951	16,284	U
72	0604604F	Submunitions	05	2,427	2,567			2,567	2,564	U
73	0604617F	Agile Combat Support	05	7,649	13,059			13,059	17,036	U

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74	0604706F	Life Support Systems	05	8,017	9,720			9,720	7,273	U
75	0604735F	Combat Training Ranges	05	7,869	9,222			9,222	33,200	U
76	0604740F	Integrated Command & Control Applications (IC2A)	05	10						U
77	0604750F	Intelligence Equipment	05	995	803			803		U
78	0604800F	F-35 - EMD	05	1,366,147	1,210,306			1,210,306	816,335	U
79	0604851F	Intercontinental Ballistic Missile - EMD	05	129,728	135,437			135,437	145,442	U
80	0604853F	Evolved Expendable Launch Vehicle Program (SPACE) - EMD	05	14,081	7,980			7,980	27,963	U
81	0604932F	Long Range Standoff Weapon	05		2,004			2,004	5,000	U
82	0604933F	ICBM Fuze Modernization	05		73,512			73,512	129,411	U
83	0605213F	F-22 Modernization Increment 3.2B	05		140,100			140,100	131,100	U
84	0605221F	KC-46	05	818,947	1,815,588			1,815,588	1,558,590	U
85	0605229F	CSAR HH-60 Recapitalization	05	11,113	123,210			123,210	393,558	U
86	0605278F	HC/MC-130 Recap RDT&E	05	21,554	19,039			19,039	6,242	U
87	0605431F	Advanced EHF MILSATCOM (SPACE)	05						272,872	U
88	0605432F	Polar MILSATCOM (SPACE)	05						124,805	U
89	0605433F	Wideband Global SATCOM (SPACE)	05						13,948	U
90	0605931F	B-2 Defensive Management System	05		281,056			281,056	303,500	U
91	0101125F	Nuclear Weapons Modernization	05	91,269	80,200			80,200	67,874	U
92	0207100F	Light Attack Armed Reconnaissance (LAAR) Squadrons	05	11,021						U

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93	0207604F	Readiness Training Ranges, Operations and Maintenance	05		310			310		U
94	0207701F	Full Combat Mission Training	05	28,917	14,861			14,861	4,663	U
95	0305230F	MC-12	05		19,949			19,949		U
96	0401138F	C-27J Airlift Squadrons	05	24,491						U
97	0401318F	CV-22	05	12,836	28,027			28,027	46,705	U
98	0401845F	Airborne Senior Leader C3 (SLC3S)	05		1,960			1,960		U
		System Development & Demonstration		3,706,414	4,966,724			4,966,724	5,078,715	
99	0604256F	Threat Simulator Development	06	26,473	22,812			22,812	17,690	U
100	0604759F	Major T&E Investment	06	60,388	42,236			42,236	34,841	U
101	0605101F	RAND Project Air Force	06	32,057	25,579			25,579	32,956	U
102	0605502F	Small Business Innovation Research	06	346,235						U
103	0605712F	Initial Operational Test & Evaluation	06	17,754	16,197			16,197	13,610	U
104	0605807F	Test and Evaluation Support	06	737,697	722,071			722,071	742,658	U
105	0605860F	Rocket Systems Launch Program (SPACE)	06	146,536	16,200			16,200	14,203	U
106	0605864F	Space Test Program (STP)	06	44,308	10,051			10,051	13,000	U
107	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support	06	44,547	42,597			42,597	44,160	U
108	0605978F	Facilities Sustainment - Test and Evaluation Support	06	27,953	27,301			27,301	27,643	U
109	0606323F	Multi-Service Systems Engineering Initiative	06	13,532	13,964			13,964	13,935	U

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110	0606392F	Space and Missile Center (SMC) Civilian Workforce	06	158,589	203,766			203,766	192,348	U
111	0702806F	Acquisition and Management Support	06	35,830	42,430			42,430	28,647	U
112	0804731F	General Skill Training	06	1,463	1,294			1,294	315	U
113	0909999F	Financing for Cancelled Account Adjustments	06	189						U
114	1001004F	International Activities	06	3,798	3,851			3,851	3,785	U
		Management Support		1,697,349	1,190,349			1,190,349	1,179,791	
115	0603423F	Global Positioning System III - Operational Control Segment	07	352,023	371,595			371,595	383,500	U
116	0604263F	Common Vertical Lift Support Platform	07	5,365						U
117	0604445F	Wide Area Surveillance	07						5,000	U
118	0605018F	AF Integrated Personnel and Pay System (AF-IPPS)	07	78,850	91,697			91,697	90,097	U
119	0605024F	Anti-Tamper Technology Executive Agency	07	35,245	17,037			17,037	32,086	U
121	0101113F	B-52 Squadrons	07	84,171	53,208			53,208	24,007	U
122	0101122F	Air-Launched Cruise Missile (ALCM)	07	782	431			431	450	U
123	0101126F	B-1B Squadrons	07	32,087	16,265			16,265	19,589	U
124	0101127F	B-2 Squadrons	07	201,688	35,970			35,970	100,194	U
125	0101313F	Strat War Planning System - USSTRATCOM	07	22,089	30,889			30,889	37,448	U
126	0101314F	Night Fist - USSTRATCOM	07	2,000	10			10		U
128	0102326F	Region/Sector Operation Control Center Modernization Program	07	6,283	5,609			5,609	1,700	U
129	0102823F	Strategic Aerospace Intelligence System Activities	07	14						U

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(Dollars in Thousands)

28 Mar 2013

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

Line No	Program Element Number	Item	Act	FY 2012 (Base & OCO)	FY 2013 Base Request with CR Adj*	FY 2013 OCO Request with CR Adj*	Emergency Disaster Relief Act of 2013	FY 2013 Total Request with CR Adj*	FY 2014 Base	Sec
130	0203761F	Warfighter Rapid Acquisition Process (WRAP) Rapid Transition Fund	07	10,280	15,098			15,098	3,844	U
131	0205219F	MQ-9 UAV	07	107,576	147,971			147,971	128,328	U
132	0207040F	Multi-Platform Electronic Warfare Equipment	07	32,431	49,848			49,848		U
133	0207131F	A-10 Squadrons	07	11,006	13,538			13,538	9,614	U
134	0207133F	F-16 Squadrons	07	128,503	190,257			190,257	177,298	U
135	0207134F	F-15E Squadrons	07	184,665	192,677			192,677	244,289	U
136	0207136F	Manned Destructive Suppression	07	8,515	13,683			13,683	13,138	U
137	0207138F	F-22A Squadrons	07	531,767	371,667			371,667	328,542	U
138	0207142F	F-35 Squadrons	07	9,682	8,117			8,117	33,000	U
139	0207161F	Tactical AIM Missiles	07	7,885	8,234			8,234	15,460	U
140	0207163F	Advanced Medium Range Air-to-Air Missile (AMRAAM)	07	75,282	87,041			87,041	84,172	U
141	0207170F	Joint Helmet Mounted Cueing System (JHMCS)	07	1,394	1,472			1,472		U
142	0207224F	Combat Rescue and Recovery	07	2,292	2,095			2,095	2,582	U
143	0207227F	Combat Rescue - Pararescue	07	914	1,119			1,119	542	U
144	0207247F	AF TENCAP	07	20,727	63,853			63,853	89,816	U
145	0207249F	Precision Attack Systems Procurement	07	3,034	1,063			1,063	1,075	U
146	0207253F	Compass Call	07	19,229	12,094			12,094	10,782	U
147	0207268F	Aircraft Engine Component Improvement Program	07	168,390	187,984			187,984	139,369	U
148	0207277F	ISR Innovations	07	16,199						U

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149	0207325F	Joint Air-to-Surface Standoff Missile (JASSM)	07	5,654	7,950			7,950	6,373	U
150	0207410F	Air & Space Operations Center (AOC)	07	116,858	76,315			76,315	22,820	U
151	0207412F	Control and Reporting Center (CRC)	07	3,288	8,653			8,653	7,029	U
152	0207417F	Airborne Warning and Control System (AWACS)	07	111,779	65,200			65,200	186,256	U
153	0207418F	Tactical Airborne Control Systems	07	7,931	5,767			5,767	743	U
154	0207423F	Advanced Communications Systems	07	20,715						U
156	0207431F	Combat Air Intelligence System Activities	07	5,428	5,756			5,756	4,471	U
157	0207438F	Theater Battle Management (TBM) C4I	07	15,009						U
158	0207444F	Tactical Air Control Party-Mod	07	8,939	16,226			16,226	10,250	U
159	0207448F	C2ISR Tactical Data Link	07	1,489	1,633			1,633	1,431	U
160	0207449F	Command and Control (C2) Constellation	07	20,075	18,086			18,086	7,329	U
161	0207452F	DCAPES	07		15,690			15,690	15,081	U
162	0207581F	Joint Surveillance/Target Attack Radar System (JSTARS)	07	71,991	24,241			24,241	13,248	U
163	0207590F	Seek Eagle	07	18,599	22,654			22,654	24,342	U
164	0207601F	USAF Modeling and Simulation	07	22,113	15,501			15,501	10,448	U
165	0207605F	Wargaming and Simulation Centers	07	5,617	5,699			5,699	5,512	U
166	0207697F	Distributed Training and Exercises	07	3,147	4,425			4,425	3,301	U
167	0208006F	Mission Planning Systems	07	61,207	69,377			69,377	62,605	U
168	0208021F	Information Warfare Support	07	2,105	7,159			7,159		U

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169	0208059F	Cyber Command Activities	07	680	66,888			66,888	68,099	U
170	0208087F	AF Offensive Cyberspace Operations	07						14,047	U
171	0208088F	AF Defensive Cyberspace Operations	07						5,853	U
179	0301400F	Space Superiority Intelligence	07	8,866	12,056			12,056	12,197	U
180	0302015F	E-4B National Airborne Operations Center (NAOC)	07	5,101	4,159			4,159	18,267	U
181	0303131F	Minimum Essential Emergency Communications Network (MEECN)	07	23,445	20,124			20,124	36,288	U
182	0303140F	Information Systems Security Program	07	88,257	69,133			69,133	90,231	U
183	0303141F	Global Combat Support System	07	435	6,512			6,512	725	U
184	0303150F	Global Command and Control System	07	2,433	4,316			4,316		U
185	0303601F	MILSATCOM Terminals	07	235,769	107,237			107,237	140,170	U
187	0304260F	Airborne SIGINT Enterprise	07	108,313	129,106			129,106	117,110	U
190	0305099F	Global Air Traffic Management (GATM)	07	4,604	4,461			4,461	4,430	U
191	0305103F	Cyber Security Initiative	07	1,920	2,055			2,055	2,048	U
192	0305105F	DoD Cyber Crime Center	07	274	285			285	288	U
193	0305110F	Satellite Control Network (SPACE)	07	17,788	33,773			33,773	35,698	U
194	0305111F	Weather Service	07	29,977	29,048			29,048	24,667	U
195	0305114F	Air Traffic Control, Approach, and Landing System (ATCALS)	07	20,644	43,187			43,187	35,674	U
196	0305116F	Aerial Targets	07	27,708	50,496			50,496	21,186	U
199	0305128F	Security and Investigative Activities	07	355	354			354	195	U

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200	0305145F	Arms Control Implementation	07		4,000			4,000	1,430	U
201	0305146F	Defense Joint Counterintelligence Activities	07	39	342			342	330	U
203	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	07	125,935	29,621			29,621		U
204	0305165F	NAVSTAR Global Positioning System (Space and Control Segments)	07	16,820	14,335			14,335		U
206	0305173F	Space and Missile Test and Evaluation Center	07	1,542	3,680			3,680	3,696	U
207	0305174F	Space Innovation, Integration and Rapid Technology Development	07	2,862	2,430			2,430	2,469	U
208	0305179F	Integrated Broadcast Service (IBS)	07						8,289	U
209	0305182F	Spacelift Range System (SPACE)	07	9,245	8,760			8,760	13,345	U
210	0305193F	Cyber Intelligence	07	1,271						U
211	0305202F	Dragon U-2	07		23,644			23,644	18,700	U
212	0305205F	Endurance Unmanned Aerial Vehicles	07	108,021	21,000			21,000	3,000	U
213	0305206F	Airborne Reconnaissance Systems	07	115,471	96,735			96,735	37,828	U
214	0305207F	Manned Reconnaissance Systems	07	13,049	13,316			13,316	13,491	U
215	0305208F	Distributed Common Ground/Surface Systems	07	82,348	63,501			63,501	7,498	U
216	0305219F	MQ-1 Predator A UAV	07	51,642	9,122			9,122	3,326	U
217	0305220F	RQ-4 UAV	07	423,301	236,265			236,265	134,406	U
218	0305221F	Network-Centric Collaborative Targeting	07	7,192	7,367			7,367	7,413	U
219	0305236F	Common Data Link (CDL)	07		38,094			38,094	40,503	U

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220	0305238F	NATO AGS	07		210,109			210,109	264,134	U
221	0305240F	Support to DCGS Enterprise	07		24,500			24,500	23,016	U
222	0305265F	GPS III Space Segment	07	444,840	318,992			318,992	221,276	U
223	0305614F	JSPOC Mission System	07	75,749	54,645			54,645	58,523	U
224	0305881F	Rapid Cyber Acquisition	07		4,007			4,007	2,218	U
225	0305887F	Intelligence Support to Information Warfare	07	13,507	13,357			13,357		U
226	0305913F	NUDET Detection System (SPACE)	07	81,989	64,965			64,965	50,547	U
227	0305940F	Space Situation Awareness Operations	07	29,720	19,586			19,586	18,807	U
228	0307141F	Information Operations Technology Integration & Tool Development	07	23,184						U
229	0308699F	Shared Early Warning (SEW)	07	1,663	1,175			1,175	1,079	U
230	0401115F	C-130 Airlift Squadron	07	6,321	5,000			5,000	400	U
231	0401119F	C-5 Airlift Squadrons (IF)	07	12,941	35,115			35,115	61,492	U
232	0401130F	C-17 Aircraft (IF)	07	81,938	99,225			99,225	109,134	U
233	0401132F	C-130J Program	07	38,345	30,652			30,652	22,443	U
234	0401134F	Large Aircraft IR Countermeasures (LAIRCM)	07	8,838	7,758			7,758	4,116	U
235	0401139F	Light Mobility Aircraft (LiMA)	07		100			100		U
236	0401218F	KC-135s	07	6,161						U
237	0401219F	KC-10s	07	30,868	24,022			24,022		U
238	0401314F	Operational Support Airlift	07	41,346	7,471			7,471	44,553	U

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239	0408011F	Special Tactics / Combat Control	07	5,040	4,984			4,984	6,213	U
240	0702207F	Depot Maintenance (Non-IF)	07	1,531	1,588			1,588	1,605	U
241	0708012F	Logistics Support Activities	07	944	577			577		U
242	0708610F	Logistics Information Technology (LOGIT)	07	47,141	119,327			119,327	95,238	U
243	0708611F	Support Systems Development	07	50,990	15,873			15,873	10,925	U
244	0804743F	Other Flight Training	07	322	349			349	1,347	U
245	0808716F	Other Personnel Activities	07	110	117			117	65	U
246	0901202F	Joint Personnel Recovery Agency	07	2,407	2,018			2,018	1,083	U
247	0901218F	Civilian Compensation Program	07	1,581	1,561			1,561	1,577	U
248	0901220F	Personnel Administration	07	1,010	7,634			7,634	5,990	U
249	0901226F	Air Force Studies and Analysis Agency	07	900	1,175			1,175	786	U
250	0901279F	Facilities Operation - Administrative	07	11,745	3,491			3,491	654	U
251	0901538F	Financial Management Information Systems Development	07	76,207	100,160			100,160	135,735	U
252	0902998F	Management HQ - ADP Support (AF)	07	290						U
9999	9999999999	Classified Programs		12,045,846	11,172,183	53,150		11,225,333	11,874,528	U
		Operational Systems Development		17,341,093	15,867,972			15,921,122	16,297,542	
253	0901560F	Continuing Resolution Programs	20		1,214,214			1,214,214		U
		Undistributed			1,214,214			1,214,214		
Total Research, Development, Test & Eval, AF				26,630,843	26,642,260			26,695,410	25,702,946	

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Budget Activity 02: Applied Research
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Budget Activity 03: Advanced Technology Development (ATD)
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Budget Activity 03: Advanced Technology Development (ATD)
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Budget Activity 04: Advanced Component Development & Prototypes (ACD&P)
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Budget Activity 05: System Development & Demonstration (SDD)
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Budget Activity 06: RDT&E Management Support
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Budget Activity 07: Operational Systems Development
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The following Program Elements are not providing RDT&E exhibits due to classification:

0101815F	ADVANCED STRATEGIC PROGRAM
0207424F	EVALUATION AND ANALYSIS PROGRAM
0208161F	SPECIAL EVALUATION SYSTEM
0208162F	ADVANCED TECHNOLOGY PROGRAM
0301310F	NATIONAL AIR INTELLIGENCE CENTER
0301314F	COBRA BALL
0301315F	MISSILE AND SPACE TECHICAL COLLECTION
0301324F	FOREST GREEN
0301386F	GDIP COLLECTION MANAGEMENT
0304111F	SPECIAL ACTIVITES
0304311F	SELECTED ACTIVITIES
0304348F	ADVANCED GEOSPATIAL INTELLIGENCE (AGI)
0305124F	SPECIAL APPLICATIONS PROGRAM
0305127F	FOREIGN COUNTERINTELLIGENCE ACTIVITES
0305159F	DEFENSE RECONNAISSANCE SUPPORT ACTIVITIES
0305172F	COMBINED ADVANCED APPLICATIONS
0605798F	ANALYSIS SUPPORT GROUP

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PROGRAM ELEMENT COMPARISON SUMMARY

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

		Remarks
BUDGET ACTIVITY #1: BASIC RESEARCH (Volume 1)		
None		
BUDGET ACTIVITY #2: APPLIED RESEARCH (Volume 1)		
None		
BUDGET ACTIVITY #3: ADVANCED TECHNOLOGY DEVELOPMENT (Volume 1)		
0603270F	ELECTRONIC COMBAT TECHNOLOGY	In FY 2014, Project 632432 activities are transferred to Project 63431G to better align efforts.
BUDGET ACTIVITY #4: ADVANCED COMPONENT DEVELOPMENT AND PROTOTYPE (Volume 2)		
0105921F	SERVICE SUPPORT TO STRATCOM - SPACE ACTIVITIES	In FY 2014, Svc Supt to Stratcom does not include New Start efforts but does reinstate RDT&E funding to the Joint Navigation Warfare Center (JNWC). For FY12 and prior years, funding for JNWC resided in PE0101313F as RDT&E Funds. In the FY13 POM, JNWC requested ~70% of their $9.6M funding be recolored to reflect increased O&M role and 30% remain as RDT&E. Funds to remain as RDT&E were incorrectly zeroed out by AF Panel under assumption that COCOM didn't need RDT&E funding. This is an effort to restore RDT&E funding in FY14 to support RDT&E activities with the right appropriation.
0207455F	THREE DIMEN LONG RANGE RADAR (3DELRR)	In FY 2014, Project 6002, Three Dimensional Expeditionary Long Range Radar (3DELRR), efforts were transferred from PE 0604283F, Battle Management Command and Control (BMC2) Sensor Development, Project 6002, in order to provide this program its own Program Element. Totals include funding for PRCP Program Number (PNO) 393, 3DELRR. In FY 2014, this is a new start.

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

0603430F	ADVANCED (EHF MILSATCOM (SPACE)	In FY 2014, Project 644050, Advanced MILSATCOM, and Project 64A030, Evolved AEHF MILSATCOM, efforts transferred to PE 0605431F, Advanced EHF MILSATCOM (Space), Project 657103, Advanced MILSATCOM, and Project 657104, Evolved AEHF MILSATCOM, in order to transition to Budget Activity 5.
0603432F	POLAR MILSATCOM (SPACE)	In FY 2014, Project 644052, Polar Satellite Communications, efforts transferred to PE 0605432F, Polar MILSATCOM (Space), Project 657105, Polar Satellite Communications, in order to transition to Budget Activity 5.
0603850F	INTEGRATED BROADCAST SERVICE (DEM/VAL)	In FY 2014, Project 644778, Integrated Broadcast Service, efforts transferred to PE 0305179F, Integrated Broadcast Service, Project Number 674779, Integrated Broadcast Service, in order to realign funds in support of transition to sustainment.
0603854F	WIDEBAND MILSATCOM (SPACE)	In FY 2014, Project 644870, Command and Control System Consolidated (CCS-C), efforts transferred to PE 0605433F, Wideband Global SATCOM (Space), Project 657102, Command and Control System Consolidated (CCS-C), in order to transitions to Budget Activity 5.
0603860F	JOINT PRECISION APPROACH AND LANDING SYSTEMS - DEM/VAL	In FY 2014, JPALS is an Acquisition Category 1D program. System development includes an incremental approach employing a family of Land-Based (fixed and deployable) and Sea-based systems. On 16 March 2007, the Joint Requirements Oversight Council (JROC) approved the Capability Development Document (CDD) for the JPALS family of systems and Increment 1 for the Sea-Based System and designated the Navy as the JPALS lead Department of Defense (DoD) Service and lead Component for the Sea-Based System. On 19 January 2010, the JROC approved Increment 2 CDD for the Land-Based System and designated the Air Force as the lead Component for the Land-Based System. As reflected in the JPALS CDD, JPALS was intended to be the next generation precision approach and landing system which would provide a common interoperable system for both DoD and civil use. A cornerstone of the JPALS implementation strategy was parallel development and implementation with the FAA Local Area Augmentation System (LAAS) which was based on the same GPS Ground Based Augmentation System (GBAS) technology. However, since the CDD was approved, the pace of the FAA LAAS implementation and phase down of the legacy instrument landing system has slowed. This, combined with the several billion dollar cost for aircraft equipage and the need to fund higher Air Force priorities, resulted in the Air Force delaying JPALS implementation for the foreseeable future. The Army has also delayed JPALS implementation beyond the current future years defense plan. As JPALS is now early to need for the Air Force, Land-Based Increment 2 development responsibility is being transferred from the Air Force to the Navy. The Navy has a near term need in FY17 for a shore based system to support Joint Strike Fighter carrier landing training ashore. The Air Force will monitor the progress of

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

		JPALS implementation but, in the interim, continue the use of the legacy Instrument Landing System (ILS). ILS is supportable through the 2030 timeframe and, in its fixed and deployable configuration, will provide an effective and affordable landing system capability. The Air Force will also retain a limited number mobile precision approach radars to provide joint Service interoperability at deployed location as all Navy and Army aircraft are not ILS equipped.
0604283F	BMC2 SENSOR DEVELOPMENT	In FY 2014, Project 6002, Three Dimensional Expeditionary Long Range Radar (3DELRR), transferred to PE 0207455F, Three Dimensional Expeditionary Long Range Radar (3DELRR), Project 6002, in order to provide this pre-Major Defense Acquisition Program its own Program Element.
0604458F	AIR AND SPACE OPERATIONS CENTER (AOC) INCREMENT 10.2	In FY 2014, Project Number 644945, AOC Inc. 10.2, efforts were transferred from PE 0207410F, AOC WS, Project Number 675117 in order to improve transparency for this major program. AOC 10.2 is PRCP Program Number (PNO) N42. In FY 2014, this is a new start.
0604618F	JOINT DIRECT ATTACK MUNITION	In FY 2014, this is a New Start.

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

0401318F	CV-22	In FY 2014, Enhanced Self Deployment Capabilities has been expanded to include new start efforts for Area Navigation (Global Positioning System) [RNAV (GPS)]. In FY 2014, the Improved Inlet Solution project includes new start efforts.
0603260F	INTELLIGENCE ADVANCED DEVELOPMENT	In FY 2014, Project Number 652053, National Air Intelligence Center, efforts were transferred from PE 0604750F, Intelligence Equipment, Project Number 652053, National Air Intelligence Center, in order to increase management efficiency, reduce administrative actions, and ensure continued minimization of effort duplication. In FY 2014, this is a new start.

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

0604222F	NUCLEAR WEAPONS SUPPORT	In FY 2014, the engineering analysis project is documented in O&M PE 0104222. In FY 2014, radiological and nuclear (RN) efforts were transferred from project 654807 to the Engineering Analysis project in O&M PE 0104222. In FY 2014 the Nuclear Surety and Certification effort was transferred to the Engineering Analysis program code in O&M PE 0104222.
0604280F	JOINT TACTICAL RADIO SYSTEMS (JTRS)	In FY 2014, Project 655068, Joint Tactical Radio System (JTRS) efforts transferred to PE 0605030F, Joint Tactical Network Center, Project 655068, Joint Tactical Radio System in order to better identify Air Force efforts for this program.
0604281F	TACTICAL DATA NETWORKS ENTERPRISE	In FY 2014, Project Number 657003, Airborne Networking Enterprise, received funds for a classified effort. This is a New Start. This is a classified effort. Details provided upon request.
0604425F	SPACE SITUATIONAL AWARENESS SYSTEMS	In FY 2014, Project 65A026, C-Band Radar is a new start effort.
0604602F	ARMAMENT/ORDNANCE DEVELOPMENT	In FY 2014, Project 653134, BLU-109 and BLU-113 Upgrade, includes new start efforts.
0604617F	AGILE COMBAT SUPPORT	In FY 2014, Project 652895, Civil Engineering Readiness, includes a Basic Airfield Expeditionary Resources (BEAR) New Start.
0604706F	LIFE SUPPORT SYSTEMS	In FY 2014, Project 65412A, Life Support Systems, includes a New Start for Aircrew Laser Eye Protection Block III.
0604750F	INTELLIGENCE EQUIPMENT	In FY 2014, Project Number 652053, National Air Intel Center, efforts transferred to PE 0603260F (BA5), Intelligence Advanced Development, Project Number 652053, National Air Intel Center, in order to increase management efficiency, reduce administrative actions, and ensure continued minimization of effort duplication.
0604851F	ICBM - EMD	In FY 2014, Project Number 655037, Support Equipment, includes the new start efforts for the Instrumentation Wafer Replacement Program (IWRP) and the Signal Conditioner Monitor Group (SCMG) replacement.
0605431F	ADVANCED EHF MILSATCOM (SPACE)	In FY 2014, Project 657103, Advanced MILSATCOM, and Project 657104, Evolved AEHF MILSATCOM, efforts transferred from PE 0603430F, Advanced EHF MILSATCOM (Space), Project 644050, Advanced MILSATCOM, and Project 64A030, Evolved AEHF MILSATCOM, in order to transition to Budget Activity 5. In FY 2014, this is a new start.

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

0605432F	POLAR MILSATCOM (SPACE)	In FY 2014, this is a new Program Element, new start. In FY 2014, Project 657105, Polar Satellite Communications, efforts were transferred from PE 0603432F, Polar MILSATCOM (Space), Project 644052, Polar Satellite Communications, in order to transition to Budget Activity 5.
0605433F	WIDEBAND GLOBAL SATCOM RDT&E (SPACE)	In FY 2014, this is a new Program Element, new start. In FY 2014, Project 657102, Command and Control System - Consolidated (CCS-C), efforts were transferred from 0603854F, Wideband Global SATCOM (Space), Project 644870, CCS-C, in order to transition to Budget Activity 5.

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

None

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

0101126F	B-1B SQUADRONS	In FY 2014, this is a New Start to replace EMD LRUs for CITS, FIDL and VSDU on two RDT&E funded test jets.
0207410F	AIR AND SPACE OPERATIONS CENTER WEAPON SYSTEM (AOC WS)	In FY 2014, project number 675117, Integration Development, AOC Increment 10.2 efforts transferred to PE 0604458F, AOC Increment 10.2, project number 644945, AOC Increment 10.2, in order to improve transparency for this major program. AOC Inc. 10.2 is PRCP Program Number (PNO) N42. In FY 2014, the Personnel Recovery Command and Control (PRC2) efforts transferred from project number 675218, Applications Development, to project number 675221, Personnel Recovery Command and Control (PRC2), in order to improve transparency for this Joint use application.

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

0207449F	C2 CONSTELLATION	In FY 2014, Project 675140, Joint Expeditionary Force Experiments (JEFX), was terminated and $9.479M was reprogrammed to meet Air Force higher priority needs.
0208006F	MISSION PLANNING SYSTEMS	In FY 2014, All MPS Modernization efforts will be centralized in project 675380 starting in FY14, including efforts previously found in project 673858.
0208021F	INFORMATION WARFARE SUPPORT	In FY 2014, 670374, Tech & Spt efforts, 670374, were transferred to PE 0305221F, Network Centric Collaborative Targeting, 675197, NCCT Core Technology, to better support and align with the Suter Program System (SPS).
0208087F	AF OFFENSIVE CYBERSPACE OPERATIONS	In FY 2014, 670374, Tech & Spt, efforts will transfer from PE 0305887F, Electronic Combat Intel Support, to PE 0208087F, Offensive Cyber Operations, 670375, Network Warfare Systems and Support, in order to align offensive cyber programs and projects under one program element. In FY 2014, this is a new start.
0208088F	AF DEFENSIVE CYBERSPACE OPERATIONS	In FY 2014, Information Systems Security Program 667820 RDTE: Firestarter efforts transferred to PE 0208088F, AF Defensive Cyberspace Operations, 667820, Computer Security RDTE: Firestarter, in order to align defensive cyber programs and projects. In FY 2014, this is a new start.
0302015F	E-4B NATIONAL AIRBORNE OPERATIONS CENTER	In FY 2014, PE 0302015F, E-4B National Airborne Operations Center includes new start efforts.
0303131F	MINIMUM ESSENTIAL EMERGENCY COMMUNICATIONS NETWORK (MEECN)	In FY 2014, Funding for this exhibit 667820 contained in PE 0208088F.
0303601F	MILSATCOM TERMINALS	In FY 2014, FY12 Congressional Add funding of $42M for FAB-T Alternative is executed from project 672489 within this program element. FY13 funding for FAB-T continues in project 672487 within this program element. FY14 funding for FAB-T continues in project 672490 within this program element. This project was funded prior to FY14 in project 672487 and 672489 within this program.
0304260F	AIRBORNE SIGINT ENTERPRISE (JMIP)	In FY 2014, 675184, RQ-4, efforts were transferred to 675181, High Altitude SIGINT, to provide visibility into all activities for both manned and unmanned high altitude platforms. PMA costs for this project will be covered under Common Development, 675183.

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

0305145F	ARMS CONTROL IMPLEMENTATION	In FY 2014, 675063, Open Skies Sensors includes new start efforts. In FY14 funding totals include $1.430M. The Open Skies Sensor program is per the direction of the Presidential Policy Directive-15 (PPD-15).
0305179F	INTEGRATED BROADCAST SERVICE	In FY 2014, Project 674779, Integrated Broadcast Service, efforts were transferred from PE 0603850F, Integrated Broadcast Service (Dem/Val), Project Number 644778, Integrated Broadcast Service, in order to realign funds in support of transition to sustainment. In FY 2014, this is a new start.
0305205F	ENDURANCE UNMANNED AERIAL VEHICLES	In FY 2014, Reduction of $5M in FY 2014 due to higher Department priorities.
0305206F	AIRBORNE RECONNAISSANCE SYSTEMS	In FY 2014, reduction of $7.889M due to higher Department priorities.
0305208F	DISTRIBUTED COMMON GROUND SYSTEMS	In FY 2014, Project 676028, Dynamic Time Critical Warfighting Capability, is being terminated because the technology development has not met objective requirements and thus has not been fielded in an operational capacity.
0305221F	NETWORK CENTRIC COLLABORATIVE TARGETING	In FY 2014, and through the FYDP, RDT&E funding for Information Operations Battle Management/SUTER Program System software (IOBM/SPS) is embedded in the Network Centric Collaborative Targeting (NCCT) Core Technology project. The funding in the Network Centric Collaborative Targeting (NCCT) RDT&E appropriation associated with Information Operations Battle Management/SUTER Program System software (IOBM/SPS BPAC 675274) is as follows: $2.235M in FY 2014, $2.265M in FY 2015, $2.331M in FY 2016, $2.540M in FY 2017, and $2.586M in FY 2018. The remaining RDT&E funding is associated with Core Technology (BPAC 675197) is as follows: $7.458M in FY 2014, $7.602M in FY 2015, $7.814M in FY 2016, $8.112M in FY 2017, and $8.258M in FY 2018.
0305887F	ELECTRONIC COMBAT INTELLIGENCE SUPPORT	In FY 2014, 670374, Tech & Spt, efforts will transfer from PE 0305887F, Electronic Combat Intel Support, to PE 0208087F, Offensive Cyber Operations, 670375, Network Warfare Systems and Support, in order to align offensive cyber programs and projects under one program element.
0604445F	WIDE AREA SURVEILLANCE	In FY 2014, Project 675895, Wide Area Surveillance includes new start efforts.
0708610F	LOGISTICS INFORMATION TECHNOLOGY (LOGIT)	In FY 2014, Project 675207, Logistics IT System Modernization includes New Start efforts.

PROGRAM ELEMENT COMPARISON SUMMARY

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

0708611F	SUPPORT SYSTEMS DEVELOPMENT	In FY 2014, project 673318, Product Data Systems Modernization (PDSM), efforts were transferred from PE 0708012F, Logistics Support Activities, project 673318, Product Data Systems Modernization (PDSM), to PE 0708611F, Support Systems Development (SSD), to better align with RDT&E activities supported by PE 0708611F, Support Systems Development (SSD).
0804743F	OTHER FLIGHT TRAINING	In FY 2014, Project 675304, Aviation Resource Management System (ARMS) is a new start effort.
0901538F	FIRST	In FY 2014, project 675177, Cost Estimating Modeling (CEM) includes new start efforts.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*					R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	347.833	361.787	373.151	-	373.151	379.833	387.765	395.622	402.882	Continuing	Continuing
613001: *Physics and Electronics*	-	104.444	112.422	107.174	-	107.174	112.149	114.116	114.233	116.953	Continuing	Continuing
613002: *Aerospace, Chemical and Material Sciences*	-	133.781	108.982	116.611	-	116.611	116.607	119.012	121.988	124.432	Continuing	Continuing
613003: *Mathematics, Information and Life Sciences*	-	99.413	119.236	119.873	-	119.873	119.966	121.900	124.693	126.808	Continuing	Continuing
613004: *Education and Outreach*	-	10.195	21.147	29.493	-	29.493	31.111	32.737	34.708	34.689	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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. All research areas are subject to long-range planning and technical review by both Air Force and tri-Service scientific planning groups. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation.

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	364.328	361.787	374.267	-	374.267
Current President's Budget	347.833	361.787	373.151	-	373.151
Total Adjustments	-16.495	0.000	-1.116	-	-1.116
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	-8.648	0.000			
• SBIR/STTR Transfer	-7.847	0.000			
• Other Adjustments	0.000	0.000	-1.116	-	-1.116

Change Summary Explanation

Decrease in FY14 is due to higher DoD priorities.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*

Reprogrammed for specific projects in accordance with Section 219 of the Duncan Hunter National Defense Authorization Act for Fiscal Year (FY) 2009, as amended by Section 2801 of the National Defense Authorization Act for FY 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*	PROJECT 613001: *Physics and Electronics*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
613001: *Physics and Electronics*	-	104.444	112.422	107.174	-	107.174	112.149	114.116	114.233	116.953	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

Basic research in the Physics and Electronics Project seeks to enable revolutionary advances and expand the fundamental knowledge supporting technologies critical to the future of the Air Force. 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. Major thrust areas being investigated in this project are complex electronics and fundamental quantum processes; plasma physics and high energy density non-equilibrium processes; and lasers and optics, electromagnetics, communication, and signal processing. Although the major thrust descriptions that follow are specific sub-areas of focus within this project, there is interest in exploring novel ideas that may bridge these major thrusts as well as those in the other projects within this program element.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Complex Electronics and Fundamental Quantum Processes	61.622	61.429	50.182
Description: Scientific focus areas are atomic and molecular physics, optical physics, photonics, quantum electronic solids, adaptive multi-mode sensing and ultra-high speed electronics, semiconductor and electromagnetic materials, and optoelectronics.			
FY 2012 Accomplishments: Demonstrated for the first time that two images can be stored and retrieved at different times in a room-temperature vapor of atoms, allowing storage of information in an atomic or quantum memory device. Explored a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, meta-materials, cathodes, di-electric and magnetic materials, semiconductor lasers, memristive systems, new classes of high-temperature superconductors, quantum dots, quantum wells and graphene. Included research to understand mechanisms of generating and controlling quantum states, such as superposition and entanglement, in photons and ultra-cold atoms and molecules.			
FY 2013 Plans: Explore a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, meta-materials, cathodes, di-electric and magnetic materials, semiconductor lasers, memristive systems, new classes of high-temperature superconductors, quantum dots, quantum wells and graphene. Includes generating and controlling quantum states, such as superposition and entanglement, in photons and ultra-cold atoms and molecules.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*	PROJECT 613001: *Physics and Electronics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to explore a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, meta-materials, cathodes, di-electric and magnetic materials, semiconductor lasers, memristive systems, new classes of high-temperature superconductors, quantum dots, quantum wells and graphene. Includes generating and controlling quantum states, such as superposition and entanglement, in photons and ultra-cold atoms and molecules.			
Title: Plasma Physics and High Energy Density Non-Equilibrium Processes ***Description:*** Scientific focus areas are electro-energetic physics and space sciences. ***FY 2012 Accomplishments:*** Created the world's smallest three-dimensional optical cavities with the potential to generate the world's most intense nanolaser beams. Explored a wide range of activities characterized by processes sufficiently energetic to require the understanding and managing of plasma phenomenology and the non-linear response of materials to high electric and magnetic fields. Included space weather, plasma control of boundary layers in turbulent flow, plasma discharges, radio frequency (RF) propagation, RF-plasma interaction, and high-power, beam-driven microwave devices. ***FY 2013 Plans:*** Explore a wide range of activities characterized by processes sufficiently energetic to require the understanding and managing of plasma phenomenology and the non-linear response of materials to high electric and magnetic fields. Includes space weather, plasma control of boundary layers in turbulent flow, plasma discharges, RF propagation, RF-plasma interaction, and high-power, beam-driven microwave devices. ***FY 2014 Plans:*** Continue to explore a wide range of activities characterized by processes sufficiently energetic to require the understanding and managing of plasma phenomenology and the non-linear response of materials to high electric and magnetic fields. Includes space weather, plasma control of boundary layers in turbulent flow, plasma discharges, RF propagation, RF-plasma interaction, and high-power, beam-driven microwave devices.	13.578	14.615	18.450
Title: Lasers and Optics, Electromagnetics, Communication and Signal Processing ***Description:*** Scientific focus areas are physical mathematics and applied analysis, electromagnetics, remote sensing and imaging physics, and surveillance and navigation. ***FY 2012 Accomplishments:*** Created a new type of optical device small enough to fit millions on a computer chip that could lead to faster, more powerful information processing and supercomputers. Explored all aspects of producing and receiving electromagnetic and electro-optical signals, as well as their propagation through complex media, including adaptive optics and optical imaging. Investigated aspects	29.244	36.378	38.542

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*	PROJECT 613001: *Physics and Electronics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
of the phenomenology of lasers including high energy lasers and non-linear optics. Included the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals. ***FY 2013 Plans:*** Explore all aspects of producing and receiving electromagnetic and electro-optical signals, as well as their propagation through complex media, including adaptive optics and optical imaging. Investigate aspects of the phenomenology of lasers including high energy lasers and non-linear optics. Includes the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals. ***FY 2014 Plans:*** Continue to explore all aspects of producing and receiving electromagnetic and electro-optical signals, as well as their propagation through complex media, including adaptive optics and optical imaging. Investigate aspects of the phenomenology of lasers including high energy lasers and non-linear optics. Includes the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals.			
Accomplishments/Planned Programs Subtotals	104.444	112.422	107.174

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*	PROJECT 613002: *Aerospace, Chemical and Material Sciences*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
613002: *Aerospace, Chemical and Material Sciences*	-	133.781	108.982	116.611	-	116.611	116.607	119.012	121.988	124.432	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

Basic research in the Aerospace, Chemical, and Materials Sciences Project seeks to enable revolutionary advances and expand the fundamental knowledge supporting technologies critical to the future of the Air Force. 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. Major thrust areas being investigated in this project are aero-structure interactions and control; energy, power, and propulsion; and complex materials and structures. Although the major thrust descriptions that follow are specific sub-areas of focus within this project, there is interest in exploring novel ideas that may bridge these major thrusts as well as those in the other projects within this program element.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Aero Structure Interactions and Control	33.445	27.245	30.148
Description: Scientific focus areas are high temperature aerospace materials, hypersonics, aerothermodynamics and turbulence, and flow interactions and control.			
FY 2012 Accomplishments: Developed new method to control an airfoil using actuators which will lead to greater air vehicle maneuverability and is being considered for applications to wind turbine research. Investigated the characterization, modeling, and exploitation of interactions between the unsteady aerodynamic flow field and the dynamic air vehicle structure to enable enhanced performance in next generation Air Force systems. Explored the synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, structures, and thermodynamics.			
FY 2013 Plans: Investigate the characterization, modeling, and exploitation of interactions between the unsteady aerodynamic flow field and the dynamic air vehicle structure to enable enhanced performance in next generation Air Force systems. Explore the synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, structures, and thermodynamics.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*	PROJECT 613002: *Aerospace, Chemical and Material Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to investigate the characterization, modeling, and exploitation of interactions between the unsteady aerodynamic flow field and the dynamic air vehicle structure to enable enhanced performance in next generation Air Force systems. Explore the synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, structures, and thermodynamics.			
Title: Energy, Power, and Propulsion ***Description:*** Scientific focus areas are thermal control, theoretical chemistry, molecular dynamics, space power and propulsion, and combustion and diagnostics. ***FY 2012 Accomplishments:*** Developed a new nanomaterials-based technology that has the potential to increase the efficiency of photovoltaic cells up to 45 percent. Exploited technological innovations and developed potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hybrid simulation, structures, and materials. Investigated processes associated with the generation, storage, and utilization of energy, specifically for Air Force systems. Included developing novel energetic materials as well as understanding and optimizing combustion processes. ***FY 2013 Plans:*** Exploit technological innovations and develop potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hybrid simulation, structures, and materials. Investigates processes associated with the generation, storage, and utilization of energy, specifically for Air Force systems. Includes developing novel energetic materials as well as understanding and optimizing combustion processes. ***FY 2014 Plans:*** Continue to exploit technological innovations and develop potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hybrid simulation, structures, and materials. Investigates processes associated with the generation, storage, and utilization of energy, specifically for Air Force systems. Includes developing novel energetic materials as well as understanding and optimizing combustion processes.	44.148	35.964	40.081
Title: Complex Materials and Structures ***Description:*** Scientific focus areas are mechanics of multifunctional materials and microsystems, multi-scale mechanics and prognosis, low density materials, and polymer chemistry. ***FY 2012 Accomplishments:*** Investigated carbon nanotube sheet research that offers key advantages for photothermal deflection. Investigated multifunctional materials and structures composed of different classes of materials that may be able to change functionality or performance characteristics to enhance the mission versatility of future air and space systems, with a key goal of increasing functionality	56.188	45.773	46.382

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*	PROJECT 613002: *Aerospace, Chemical and Material Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
while decreasing weight and volume. Explored complex materials, microsystems, and structures that incorporate hierarchical design and functionality from the nano-scale through the meso-scale, ultimately leading to controlled, well-understood material or structural behavior capable of dynamic functionality and/or performance characteristics to enhance mission versatility. ***FY 2013 Plans:*** Investigate multifunctional materials and structures composed of different classes of materials that may be able to change functionality or performance characteristics to enhance the mission versatility of future air and space systems, with a key goal of increasing functionality while decreasing weight and volume. Explore complex materials, microsystems, and structures that incorporate hierarchical design and functionality from the nano-scale through the meso-scale, ultimately leading to controlled, well-understood material or structural behavior capable of dynamic functionality and/or performance characteristics to enhance mission versatility. ***FY 2014 Plans:*** Continue to investigate multifunctional materials and structures composed of different classes of materials that may be able to change functionality or performance characteristics to enhance the mission versatility of future air and space systems, with a key goal of increasing functionality while decreasing weight and volume. Explore complex materials, microsystems, and structures that incorporate hierarchical design and functionality from the nano-scale through the meso-scale, ultimately leading to controlled, well-understood material or structural behavior capable of dynamic functionality and/or performance characteristics to enhance mission versatility.			
Accomplishments/Planned Programs Subtotals	133.781	108.982	116.611

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*	PROJECT 613003: *Mathematics, Information and Life Sciences*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
613003: *Mathematics, Information and Life Sciences*	-	99.413	119.236	119.873	-	119.873	119.966	121.900	124.693	126.808	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

Basic research in the Mathematics, Information, and Life Sciences Project seeks to enable revolutionary advances and expand the fundamental knowledge supporting technologies critical to the future of the Air Force. 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. Major thrust areas being investigated in this project are information and complex networks, decision making, dynamical systems, optimization and control, and natural materials and systems. Although the major thrust descriptions that follow are specific sub-areas of focus within this project, there is interest in exploring novel ideas that may bridge these major thrusts as well as those in the other projects within this program element.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Information and Complex Networks	27.836	34.386	34.542
Description: Scientific focus areas are systems and software, information operations and security, information fusion, and complex networks.			
FY 2012 Accomplishments: Studied feedback failure correction mechanisms that can augment software to adapt to failures and continue to function in the presence of residual defects. Designed and analyzed techniques to enable reliable and secure exchange of information and predictable operation of networks and systems. Included traditional aspects of information assurance, software engineering, and reliable systems, but the emphasis was on the underlying mathematics of secure-by-design architectures of networked communications and neural information processing. Sub-areas included system and network performance prediction, design and analysis, and modeling of human-machine systems.			
FY 2013 Plans: Design and analyze techniques to enable reliable and secure exchange of information and predictable operation of networks and systems. Includes traditional aspects of information assurance, software engineering, and reliable systems, but the emphasis is on the underlying mathematics of secure-by-design architectures of networked communications and neural information processing. Sub-areas include system and network performance prediction, design and analysis, and modeling of human-machine systems.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*	PROJECT 613003: *Mathematics, Information and Life Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to design and analyze techniques to enable reliable and secure exchange of information and predictable operation of networks and systems. Includes traditional aspects of information assurance, software engineering, and reliable systems, but the emphasis is on the underlying mathematics of secure-by-design architectures of networked communications and neural information processing. Sub-areas include system and network performance prediction, design and analysis, and modeling of human-machine systems.			
Title: Decision Making ***Description:*** Scientific focus areas are mathematical modeling of cognition and decision making, and collective behavior and socio-cultural modeling. ***FY 2012 Accomplishments:*** Developed a model based on the geographical size of groups to quantify and predict the possibility of social violence. Investigated new mathematical laws, scientific principles, and robust algorithms that underlie intelligent, mixed human-machine decision making to achieve accurate real-time projection of expertise and knowledge into and out of the battlespace. Included efforts to advance the critical knowledge base in information sciences and information fusion, and to model individual and group cognitive processing and decision making. ***FY 2013 Plans:*** Investigate new mathematical laws, scientific principles, and robust algorithms that underlie intelligent, mixed human-machine decision making to achieve accurate real-time projection of expertise and knowledge into and out of the battlespace. Includes efforts to advance the critical knowledge base in information sciences and information fusion, and to model individual and group cognitive processing and decision making. ***FY 2014 Plans:*** Continue to investigate new mathematical laws, scientific principles, and robust algorithms that underlie intelligent, mixed human-machine decision making to achieve accurate real-time projection of expertise and knowledge into and out of the battlespace. Includes efforts to advance the critical knowledge base in information sciences and information fusion, and to model individual and group cognitive processing and decision making.	13.918	18.693	21.013
Title: Dynamical Systems, Optimization, and Control ***Description:*** Scientific focus areas are computational mathematics, dynamics and control, and optimization and discrete mathematics. ***FY 2012 Accomplishments:*** Designed a three-dimensional virtual reality tracking system to charactize sensory-motor feedback mechanisms in an insect brain that could inspire new approaches to flight control stabilization and navigation. Developed new scientific concepts supported	37.776	42.309	38.185

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*	PROJECT 613003: *Mathematics, Information and Life Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
by rigorous analysis for advancing the science of autonomy and promoting the understanding necessary to analyze and design complex multi-scale systems as well as provide guaranteed levels of performance. Included study of novel adaptive control strategies for coordinating heterogeneous, autonomous, or semi autonomous aerospace vehicles in uncertain, information rich, dynamically changing, adversarial, and networked environments. ***FY 2013 Plans:*** Develop new scientific concepts supported by rigorous analysis for advancing the science of autonomy and promoting the understanding necessary to analyze and design complex multi-scale systems as well as provide guaranteed levels of performance. Includes study of novel adaptive control strategies for coordinating heterogeneous, autonomous, or semi-autonomous aerospace vehicles in uncertain, information rich, dynamically changing, adversarial, and networked environments. ***FY 2014 Plans:*** Continue to develop new scientific concepts supported by rigorous analysis for advancing the science of autonomy and promoting the understanding necessary to analyze and design complex multi-scale systems as well as provide guaranteed levels of performance. Includes study of novel adaptive control strategies for coordinating heterogeneous, autonomous, or semi-autonomous aerospace vehicles in uncertain, information rich, dynamically changing, adversarial, and networked environments.			
Title: Natural Materials and Systems ***Description:*** Scientific focus areas are renewable energy, natural materials and nature inspired systems. ***FY 2012 Accomplishments:*** Created a new crystal erbium compound in the form of single-crystal nanowire that offers superior optical properties. Investigated multi-disciplinary approaches for studying, using, mimicking, synthesizing and adapting to the ways natural systems accomplish their required tasks. Studied how to adapt and mimic existing natural sensory systems and add existing capabilities to these organisms with the intent to gain more precise control over their material production. ***FY 2013 Plans:*** Investigate multi-disciplinary approaches for studying, using, mimicking, synthesizing and adapting to the ways natural systems accomplish their required tasks. Study how to adapt and mimic existing natural sensory systems and add existing capabilities to these organisms with the intent to gain more precise control over their material production. ***FY 2014 Plans:*** Continue to investigate multi-disciplinary approaches for studying, using, mimicking, synthesizing and adapting to the ways natural systems accomplish their required tasks. Study how to adapt and mimic existing natural sensory systems and add existing capabilities to these organisms with the intent to gain more precise control over their material production.	19.883	23.848	26.133
Accomplishments/Planned Programs Subtotals	99.413	119.236	119.873

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*	PROJECT 613003: *Mathematics, Information and Life Sciences*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*	PROJECT 613004: *Education and Outreach*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
613004: *Education and Outreach*	-	10.195	21.147	29.493	-	29.493	31.111	32.737	34.708	34.689	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

The major thrust areas in the Science and Technology (S&T) Education and Outreach 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 benefit the Air Force by increasing awareness of Air Force basic research priorities in the research community as a whole, and attracting 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 interactions with Historically Black Colleges and Universities, Hispanic serving institutions, and other minority institutions.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Outreach to International S&T Community	5.125	9.935	12.907
Description: Foster international S&T cooperation by supporting direct interchanges with a broad range of key international researchers and communities. Identify and leverage international scientific advances when appropriate.			
FY 2012 Accomplishments: Collaborated with Australia and Brazil on hypersonics research. Leveraged international expertise and supported international technology liaison missions to identify and maintain awareness of foreign science and technology developments. Explored current foreign investments and influenced world-class scientific research on specific topics of Air Force interest. Pursued access to technical information on foreign research capabilities within our interests. Supported international visits by scientists and high-level Department of Defense (DoD) S&T delegations, and provided primary interface to coordinate international S&T participation among DoD organizations.			
FY 2013 Plans: Leverage international expertise and support international technology liaison missions to identify and maintain awareness of foreign science and technology developments. Explore current foreign investments and influence world-class scientific research on specific topics of Air Force interest. Pursue access to technical information on foreign research capabilities within our interests. Support international visits by scientists and high-level DoD S&T delegations, and provide primary interface to coordinate international S&T participation among DoD organizations.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*	PROJECT 613004: *Education and Outreach*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to leverage international expertise and support international technology liaison missions to identify and maintain awareness of foreign science and technology developments. Explore current foreign investments and influence world-class scientific research on specific topics of Air Force interest. Pursue access to technical information on foreign research capabilities within our interests. Support international visits by scientists and high-level DoD S&T delegations, and provide primary interface to coordinate international S&T participation among DoD organizations.			
Title: Outreach to U.S. S&T Workforce ***Description:*** Strengthen science, mathematics, and engineering research and infrastructure in the U.S., thereby strengthening current and future Air Force S&T capabilities. ***FY 2012 Accomplishments:*** Awarded 48 grants through the Air Force's Young Investigator Research Program. Increased awareness of Air Force research needs and opportunities throughout the civilian scientific community, while simultaneously identifying, recruiting, and increasing opportunities for new young investigators to participate in critical Air Force research. Supported science, mathematics, and engineering research, and educational outreach programs at U.S. colleges and universities, including historically black colleges and universities, Hispanic serving institutions, and other minority institutions. ***FY 2013 Plans:*** Increase awareness of Air Force research needs and opportunities throughout the civilian scientific community, while simultaneously identifying, recruiting, and increasing opportunities for new young investigators to participate in critical Air Force research. Support science, mathematics, and engineering research, and educational outreach programs at U.S. colleges and universities, including historically black colleges and universities, Hispanic serving institutions, and other minority institutions. ***FY 2014 Plans:*** Continue to increase awareness of Air Force research needs and opportunities throughout the civilian scientific community, while simultaneously identifying, recruiting, and increasing opportunities for new young investigators to participate in critical Air Force research. Support science, mathematics, and engineering research at U.S. colleges and universities, including historically black colleges and universities, Hispanic serving institutions, and other minority institutions.	5.070	11.212	16.586
Accomplishments/Planned Programs Subtotals	10.195	21.147	29.493

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102F: *Defense Research Sciences*	PROJECT 613004: *Education and Outreach*

D. Acquisition Strategy

N/A

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*					R-1 ITEM NOMENCLATURE PE 0601103F: *University Research Initiatives*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	131.957	141.153	138.333	-	138.333	140.738	142.280	143.941	146.532	Continuing	Continuing
615094: *University Research Initiatives*	-	131.957	141.153	138.333	-	138.333	140.738	142.280	143.941	146.532	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program supports defense-related basic research in a wide range of scientific and engineering disciplines relevant to maintaining U.S. military technology superiority. Research topics include, but are not limited to, transformational and high priority technologies such as nanotechnology, sensor networks, intelligence information fusion, smart materials and structures, efficient energy and power conversion, and high-energy materials for propulsion and control. The program also enhances and promotes the education of U.S. scientists and engineers in disciplines critical to maintaining, advancing, and enabling future U.S. defense technologies. For example, the National Defense Science and Engineering Graduate (NDSEG) program awards fellowships to train U.S citizens in science and engineering disciplines of military importance under a joint tri-Service and Office of the Assistant Secretary of Defense for Research and Engineering competition. Finally, this program 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 inter-disciplinary efforts. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. This program is in Budget Activity 1, Basic Research, because it funds basic scientific study and experimentation.

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	152.273	141.153	138.747	-	138.747
Current President's Budget	131.957	141.153	138.333	-	138.333
Total Adjustments	-20.316	0.000	-0.414	-	-0.414
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	-16.000	0.000			
• SBIR/STTR Transfer	-4.316	0.000			
• Other Adjustments	0.000	0.000	-0.414	-	-0.414

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103F: *University Research Initiatives*

Change Summary Explanation

Decrease in FY14 is due to higher DoD priorities.

Realigned Congressional Add to PE 0602788F Dominant Information Technology to better align efforts; Realigned funding to PE 0602203F Aerospace Propulsion for the Adaptive Versatile Engine Technology (ADVENT) project to better align efforts.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Multidisciplinary University Research Initiative	73.237	78.341	76.776
Description: Promote fundamental, multi- and interdisciplinary science and engineering research projects. ***FY 2012 Accomplishments:*** Selected six new projects for grants under the Multidisciplinary University Research Initiative (MURI) program to fund basic research in metamaterials, photonics, and nanoenergetics. Supported and recognized superior academic researchers in the early stages of their careers through the Presidential Early Career Award for Scientists and Engineers (PECASE) program. Funded multi-disciplinary programs initially awarded in prior years. ***FY 2013 Plans:*** Continue funding competitive research grants at U.S. universities that focus on significantly expanding the basic knowledge of Air Force-relevant science and technology areas, not normally achievable in smaller funded, single investigator awards. Support and recognize superior academic researchers in the early stages of their careers through the PECASE program. Continue funding of multi-disciplinary programs initially awarded in prior years. ***FY 2014 Plans:*** Continue funding competitive research grants at U.S. universities that focus on significantly expanding the basic knowledge of Air Force-relevant science and technology areas, not normally achievable in smaller funded, single investigator awards. Support and recognize superior academic researchers in the early stages of their careers through the PECASE program. Continue funding of multi-disciplinary programs initially awarded in prior years.			
Title: Science and Engineering Education	43.810	46.863	45.927
Description: Support post-graduate, graduate, and undergraduate education in science and engineering disciplines at U.S. universities. ***FY 2012 Accomplishments:*** Supported undergraduate research in science and engineering at 65 institutions through the Awards to Stimulate and Support Undergraduate Research Experiences (ASSURE) program. Supported competitive awards for graduate and undergraduate			

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601103F: *University Research Initiatives*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
research experiences. Awarded highly competitive National Defense Science and Engineering Graduate (NDSEG) fellowships. Funded awards initiated under prior year Department of Defense (DoD) programs. ***FY 2013 Plans:*** Continue to award highly competitive NDSEG fellowships. Continue to support competitive awards for graduate and undergraduate research experiences, including those established under the ASSURE program. Continue funding for awards initiated under prior year DoD programs. ***FY 2014 Plans:*** Continue to award highly competitive NDSEG fellowships. Continue to support competitive awards for graduate and undergraduate research experiences, including those established under the ASSURE program. Continue funding for awards initiated under prior year DoD programs.			
Title: Research Instrumentation ***Description:*** Enhance scientific and engineering research through advanced education infrastructure and instrumentation at U.S. universities. ***FY 2012 Accomplishments:*** Selected over 30 projects at U.S. universities for grants under the Defense University Research Instrumentation Program (DURIP) to acquire state-of-the-art, high technology instrumentation and infrastructure to enhance research and educational capabilities. New projects include experimental equipment for distributed engine analysis and control, and instrumentation for space plasma simulations. ***FY 2013 Plans:*** Continue to award grants on a competitive basis under the DURIP to U.S. universities to acquire state-of-the-art, high technology instrumentation and infrastructure to enhance research and educational capabilities. ***FY 2014 Plans:*** Continue to award grants on a competitive basis under the DURIP to U.S. universities to acquire state-of-the-art, high technology instrumentation and infrastructure to enhance research and educational capabilities.	14.910	15.949	15.630
Accomplishments/Planned Programs Subtotals	131.957	141.153	138.333

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601103F: *University Research Initiatives*

E. Acquisition Strategy

N/A

F. 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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*					R-1 ITEM NOMENCLATURE PE 0601108F: *High Energy Laser Research Initiatives*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	13.819	13.094	13.286	-	13.286	13.275	13.545	13.946	14.196	Continuing	Continuing
615097: *High Energy Laser Research Initiatves*	-	13.819	13.094	13.286	-	13.286	13.275	13.545	13.946	14.196	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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. This programs funds multi-disciplinary research institutes to conduct research on laser and beam control technologies. In addition, this program supports educational grants to stimulate interest in HELs. These educational grants are used for educational tools, scholarships, and summer intern employees in military laboratories. Efforts in this program have been coordinated through the DoD Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation.

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	14.258	13.094	13.326	-	13.326
Current President's Budget	13.819	13.094	13.286	-	13.286
Total Adjustments	-0.439	0.000	-0.040	-	-0.040
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-0.439	0.000			
• Other Adjustments	0.000	0.000	-0.040	-	-0.040

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: HEL Devices	9.031	8.494	8.406
Description: Improve the fundamental understanding of HEL sources, to include solid state, free electron, and gas laser technologies.			
FY 2012 Accomplishments:			

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601108F: *High Energy Laser Research Initiatives*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Initiated a new call for innovative laser technologies. Awarded 10 new university grants in diode-pumped alkali, short-pulse, free electron, fiber, and solid state laser technologies. Continued overseas efforts to leverage international technology advancements. ***FY 2013 Plans:*** Continue development of innovative laser technologies including diode-pumped alkali, short-pulse, free electron, fiber and solid state laser technologies. Continue overseas efforts to leverage international technology advancements. ***FY 2014 Plans:*** Continue development of innovative laser technologies including diode-pumped alkali, short-pulse, free electron, fiber, and solid state laser technologies. Continue overseas efforts to leverage international technology advancements.			
Title: HEL Beam Control ***Description:*** Improve the fundamental understanding of beam control technologies, as they relate to HEL applications. Conduct research in atmospheric characterization, metrology, control systems, algorithms, and beam control component technology. ***FY 2012 Accomplishments:*** Initiated a new call for innovative beam control architectures and then awarded three grants for transonic aero-optics research, laser propagation in deep turbulence, and optical coatings on large area optics. Continued overseas efforts to leverage international technology advancements. ***FY 2013 Plans:*** Continue research on innovative beam control architectures. Continue overseas efforts to leverage international technology advancements. ***FY 2014 Plans:*** Continue research on innovative beam control architectures. Continue overseas efforts to leverage international technology advancements.	4.038	3.850	4.130
Title: HEL Education ***Description:*** Fund educational grants intended to stimulate interest in HELs among students. ***FY 2012 Accomplishments:*** Provided scholarships and internships to support college students studying HEL degrees. Provided grants to Service Academies to stimulate HEL studies among military cadets. Funded publication of journals and continuing education for professionals in the HEL field. ***FY 2013 Plans:***	0.750	0.750	0.750

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601108F: *High Energy Laser Research Initiatives*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Provide scholarships and internships to support college students studying HEL degrees. Provide grants to Service Academies to stimulate HEL studies among military cadets. Fund publication of journals and continuing education for professionals in the HEL field. ***FY 2014 Plans:*** Provide scholarships and internships to support to college students studying HEL degrees. Provide grants to Service Academies to stimulate HEL studies among military cadets. Fund publication of journals and continuing education for professionals in the HEL field.			
Accomplishments/Planned Programs Subtotals	13.819	13.094	13.286

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A

F. 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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*					R-1 ITEM NOMENCLATURE PE 0602102F: *Materials*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	142.417	114.166	116.846	-	116.846	116.504	118.484	116.758	119.016	Continuing	Continuing
624347: *Materials for Structures, Propulsion, and Subsystems*	-	88.824	58.464	60.381	-	60.381	53.257	52.689	51.543	52.609	Continuing	Continuing
624348: *Materials for Electronics, Optics, and Survivability*	-	30.017	28.805	30.302	-	30.302	30.404	32.586	33.046	33.627	Continuing	Continuing
624349: *Materials Technology for Sustainment*	-	19.785	26.897	26.163	-	26.163	32.843	33.209	32.169	32.780	Continuing	Continuing
624915: *Deployed Air Base Technology*	-	3.791	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 four projects that develop: (1) structural, propulsion, and sub-systems materials and processes technologies; (2) electronic, optical, and survivability materials and processes technologies; (3) sustainment materials, processes technologies, and advanced non-destructive inspection methodologies; and (4) air base operations technologies including deployable base infrastructure, force protection, and fire fighting capabilities. Efforts in the program have been coordinated through the coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary materials technologies.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602102F: *Materials*

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	144.219	114.166	121.176	-	121.176
Current President's Budget	142.417	114.166	116.846	-	116.846
Total Adjustments	-1.802	0.000	-4.330	-	-4.330
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-1.802	0.000			
• Other Adjustments	0.000	0.000	-4.330	-	-4.330

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2012	FY 2013
Project: 624347: *Materials for Structures, Propulsion, and Subsystems*		
Congressional Add: *Nanotechnology Research*	8.000	-
Congressional Add Subtotals for Project: 624347	8.000	0.000
Congressional Add Totals for all Projects	8.000	0.000

Change Summary Explanation

Decrease in FY14 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602102F: *Materials*	PROJECT 624347: *Materials for Structures, Propulsion, and Subsystems*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
624347: *Materials for Structures, Propulsion, and Subsystems*	-	88.824	58.464	60.381	-	60.381	53.257	52.689	51.543	52.609	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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. The project 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. The project develops nanostructured and biological materials for aircraft structures, munitions, air vehicle subsystems, and personnel. The project develops novel materials for electromagnetic interactions with matter for electromagnetic pulse (EMP), high power microwave, and lightning strike protection. The project concurrently develops advanced processing methods to enable adaptive processing of aerospace materials.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Composites	12.630	17.628	19.770
Description: Develop ceramic, ceramic matrix composite, and hybrid materials technologies for performance and supportability improvement in propulsion systems and high temperature aerospace structures.			
FY 2012 Accomplishments: Advanced development of new processing methods, environmental coatings, and life prediction for higher temperature capable ceramic matrix composites. Continued validation of the life prediction model to address time dependent degradation associated with environmental exposure. Continued validation of the severe environment durability of advanced ceramic composite systems with advanced interfaces via mechanical testing. Continued development of new ceramic matrix composites systems with higher temperature capability. Continued validation of suitable materials and materials process technologies for applications in combined optical and radio frequency (RF) communication system apertures. Initiated development of new hybrid materials and materials process technologies for applications in combined optical and RF communication system apertures.			
FY 2013 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue development of new advanced processing methods, coating technologies, and behavioral life prediction for higher temperature capable ceramic matrix composites. Transition life prediction model to address time dependent degradation associated with environmental exposure. Demonstrate severe environment durability of advanced ceramic composite systems via mechanical testing. Advance development of new ceramic matrix composites systems with higher temperature capability. Demonstrate materials and processes for applications in combined optical and RF communication system apertures. Continue development of new hybrid materials and processes for applications in combined optical and RF communication system apertures. Develop ceramic and organic matrix composite materials and processes for propulsion systems and aerospace structures. Use computational analysis to enhance understanding of environment for structural characterization. ***FY 2014 Plans:*** Continue to analyze and develop new advanced processing methods, coating technologies, and behavioral life prediction for higher temperature capable ceramic matrix composites. Continue transition of life prediction model to address time dependent degradation associated with environmental exposure. Continue to demonstrate severe environment durability of advanced ceramic composite systems via mechanical testing. Advance development of new ceramic matrix composites systems with higher temperature capability. Continue to demonstrate materials and processes for applications in combined optical and RF communication system apertures. Continue to analyze and develop new hybrid materials and processes for applications in combined optical and RF communication system apertures. Continue to develop ceramic and organic matrix composite materials and processes for propulsion systems and aerospace structures. Use computational analysis to enhance understanding of environment for structural characterization.			
Title: Metamaterials ***Description:*** Develop nanostructured materials and nanoscale architectures to address electromagnetic applications. Develop metamaterials for sensors, antennas, electronics, and optical elements. ***FY 2012 Accomplishments:*** Investigated new material systems and nano geometries to improve electrochemical energy storage including development of long-life electrodes. Accelerated applications development for optical metamaterials. Investigated concepts for RF passive metamaterials-based components. Continued to develop RF/Infrared (IR) photonics for compact air vehicle applications. Continued to develop fabrication and characterization for Electro-optic (EO)/IR metamaterials and emerging metamaterial applications. ***FY 2013 Plans:***	20.371	6.669	3.500

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Demonstrate concepts for RF passive metamaterials-based components. Demonstrate use of RF/IR photonics for compact air vehicle applications. Analyze nanoscale materials to understand and characterize the transport of mass, momentum, and energy at the atomic level. Note: In FY13, decrease is due to higher Department of Defense priorities. ***FY 2014 Plans:*** Continue to demonstrate concepts for RF Passive metamaterials based components. Continue to develop metamaterials for multiple applications. Continue to analyze nanoscale materials to understand and characterize the transport of mass, momentum, and energy at the atomic level.			
Title: Metals ***Description:*** Develop lightweight metallic/inter-metallic high temperature materials, life prediction, and metals processing technologies for sustainment issues such as lower costs, increased durability, and improved reliability. ***FY 2012 Accomplishments:*** Continued development of advanced blade and disk system concept for insertion into advanced propulsion concepts for air platforms. Continued development of advanced computation methods to support material development and characterization modeling for advanced aerospace systems. Continued development and validation of quantitative, predictive models for performance of metallic-based thermal management systems. Determined relationships between microstructure, processing, and the functional properties and performance of metallic, hybrid, nano, and composite materials. ***FY 2013 Plans:*** Transition advanced blade and disk system into advanced turbine engine systems. Demonstrate advanced computation methods to support material development and characterization modeling. Demonstrate quantitative, predictive models for performance of metallic based thermal management systems. Analyze relationships between microstructure, processing, functional properties, and performance of metallic, hybrid, nanoscale, and composite materials. Develop metals materials and processes for higher reliability, lower cost and more durability sustainment propulsion systems and aerospace structures. Initiate development of advanced electromagnetic protection technologies for propulsion systems and aerospace structures. ***FY 2014 Plans:*** Continue to demonstrate advanced computation methods to support material development and characterization modeling. Continue to demonstrate quantitative, predictive models for performance of metallic based thermal management systems. Analyze relationships between microstructure, processing, functional properties, and performance of metallic, hybrid, nanoscale, and composite materials. Continue to develop metals materials and processes for higher reliability, lower cost and more	13.442	20.566	21.711

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
durability sustainment propulsion systems and aerospace structures. Continue to develop advanced electromagnetic protection technologies for propulsion systems and aerospace structures.			
Title: Hypersonic Materials ***Description:*** Explore new material systems for expendable supersonic/hypersonic weapon system applications. Develop and evaluate lightweight, active, adaptive, multifunctional, high temperature, and durable composite and hybrid materials for extreme environments. Develop composite and hybrid life prediction tools for engine and airframe applications. Develop computational materials science techniques and models to characterize high performance materials for expendable space and supersonic/ hypersonic applications. ***FY 2012 Accomplishments:*** Continued to demonstrate improved performance of new material systems for space and supersonic/hypersonic vehicle applications. Continued to develop lightweight, active, adaptive, multifunctional, high temperature, and durable composite and hybrid materials for extreme environments including hypersonic applications. Evaluated advanced carbon fibers modified by carbon nanotubes. Developed tailorable/adaptive high performance thermal interfaces, coolants, thermoelectric, and energy storage materials and models for air, space, propulsion, and directed energy applications. Initiated development of novel materials and processes for improved thermal transport, storage, and thermal management for Air Force applications. Continued to transition high-performance material systems for space and high-speed vehicle applications. Developed composite and hybrid life prediction tools for engine and airframe applications. ***FY 2013 Plans:*** Evaluate advanced carbon fibers modified by carbon nanotubes. Develop tailorable/adaptive high performance thermal interfaces, coolants, thermoelectric, and energy storage materials and models for air, space, propulsion, and directed energy applications. Develop novel materials and processes for improved thermal transport, storage, and thermal management for Air Force applications. Develop composite and hybrid life prediction tools for engine and airframe applications. ***FY 2014 Plans:*** Continue to evaluate advanced carbon fibers modified by carbon nanotubes. Continue to develop tailorable/adaptive high performance thermal interfaces, coolants, thermoelectric, and energy storage materials and models for air, space, propulsion, and directed energy applications. Continue development of novel materials and processes for improved thermal transport, storage, and thermal management for Air Force applications. Continue to develop composites for high performance extreme environments.	15.309	6.821	8.800
Title: Alternative Energy Materials ***Description:*** Develop materials for power, fluids, lubricants, aircraft topcoat, and corrosion resistant coatings using alternative energy and bio-inspired concepts.	2.688	0.000	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Demonstrated alternative/renewable energy materials and technologies for deployed applications. Successfuly matured thermal/ friction coating materials for extreme environments. ***FY 2013 Plans:*** Work completed in FY12. ***FY 2014 Plans:*** N/A			
Title: Nano-energetic and Nano-biomaterials ***Description:*** Develop the basic nanomaterial building blocks for munitions and propulsion energetic systems. Develop fundamental science and technology for pervasive device processing mechanisms via bio-inspired concepts and nanoscale technologies. ***FY 2012 Accomplishments:*** Demonstrated and validated nanomaterials for structural nano-energetic (SNE) munitions, high efficiency air-breathing propulsion, and access to space. Developed biological engineering methods to facilitate the generation of sensors, materials, and electro-optic devices for production of complex hybrid materials. Investigated the confluence on nano-materials and bio-materials focusing on transitioning mechanical optical or electronic devices based upon nano-materials and bio-materials. ***FY 2013 Plans:*** Develop and analyze nano-biomaterials for human performance sensing. Develop computation materials science techniques and models to characterize nanomaterials. ***FY 2014 Plans:*** Continue to develop and analyze nano-biomaterials for human performance sensing. Validate computation materials science techniques and models to characterize nanomaterials.	13.732	6.780	6.600
Title: High Temperature Materials ***Description:*** Develop high temperature materials, structures, and thermal management concepts to enable furture defense capabilities for prompt global strike concepts. ***FY 2012 Accomplishments:***	2.652	0.000	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Successfully matured and transitioned advanced ceramics, ceramic matrix composites, hybrids, and metallic concepts for reuseable hot structure and thermal protection systems. ***FY 2013 Plans:*** Work completed in FY12. ***FY 2014 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	80.824	58.464	60.381

	FY 2012	FY 2013
Congressional Add: Nanotechnology Research ***FY 2012 Accomplishments:*** Conducted Congressionally-directed effort.	8.000	-
Congressional Adds Subtotals	8.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602102F: *Materials*	PROJECT 624348: *Materials for Electronics, Optics, and Survivability*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
624348: *Materials for Electronics, Optics, and Survivability*	-	30.017	28.805	30.302	-	30.302	30.404	32.586	33.046	33.627	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Infrared Detector Materials	8.295	9.362	9.600
Description: Develop IR detector and hybrid materials, materials and processes technologies for performance, affordability, and operational capability of surveillance, tracking, targeting, and situational awareness systems.			
FY 2012 Accomplishments: Demonstrated reproducibility of optimized 2000-by-2000 (2k x 2k) detector and readout integrated circuit design, processing, and packaging for enhanced focal plane array yields. Developed a super-lattice based material system for use in the detector elements of very long wavelength IR detector focal plane arrays. Continued to advance mid-wavelength materials development for high temperature, low-noise operation for use on low-power systems. Validated models of materials optical/IR behavior for low observable (LO), Intelligence, Surveillance, and Reconnaissance (ISR), and other applications. Initiate development of materials for nano-scale detection.			
FY 2013 Plans: Transition optimized design of 2k x 2k IR detectors with integrated circuits, processing, and packaging for enhanced focal plane array yields. Continue to develop a super-lattice based material system for use in the detector elements of very-long wavelength IR detector focal plane arrays. Operate a mid-wave IR (MWIR) focal plane array at temperatures above 200 Kelvin to demonstrate overcoming the challenge of cryogenic cooling requirements. Transition mid-wavelength materials for high temperature, low-noise sensing for use on low power systems. Demonstrate models of materials optical/infrared behavior for LO, ISR, and other			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
applications. Continue to develop nano-scale materials for use in producing detectors. Utilize computational materials science to improve performance prediction models. Develop inorganic quantum materials for aerospace applications. ***FY 2014 Plans:*** Develop materials for use in high resolution MWIR applications. Develop materials to support and provide persistent air ISR. Continue to demonstrate models of materials optical/infrared behavior for LO, ISR, and other applications. Continue to develop nano-scale materials for use in producing detectors. Continue to utilize computational materials science to improve performance prediction models. Continue to develop inorganic quantum materials for aerospace applications.			
Title: Laser Hardened Materials ***Description:*** Develop and demonstrate technologies to enhance the safety, survivability, and mission effectiveness of aircrews, sensors, viewing systems, and related assets. ***FY 2012 Accomplishments:*** Continued demonstration of optimized nonlinear optical limiter materials for damage protection and development of new optical limiter materials and material technologies for robust in-band protection. Continued demonstration of enhanced photorefractive hybrid materials concepts for passive protection applications. Developed tunable/switchable materials and concepts to provide jamming protection to a variety of systems. Developed and demonstrated passive optical coating technology for advanced applications in airborne, space, and personnel systems. ***FY 2013 Plans:*** Continue development and demonstration of materials and technologies to protect against directed energy threats. Projects include optimized nonlinear optical limiter materials for damage protection, robust in-band optical limiter materials, enhanced photorefractive hybrid materials concepts, tunable/switchable materials and concepts, and passive optical coating technology for advanced applications in airborne, space, and personnel systems. Develop materials for high energy laser interactions. Utilize computational materials science to enhance multi-scale modeling. Develop materials and processes for hardening and optical materials applications. ***FY 2014 Plans:*** Validate and demonstrate materials and technologies to protect against directed energy threats. Projects include optimized nonlinear optical limiter materials for damage protection, robust in-band optical limiter materials, enhanced photorefractive hybrid materials concepts, tunable/switchable materials and concepts, and passive optical coating technology for advanced applications in airborne, space, and personnel systems. Continue to develop materials for high energy laser interactions. Utilize computational	8.728	11.818	12.223

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
materials science to enhance multiscale modeling. Continue to develop materials and processes for hardening and optical materials applications.			
Title: High Power/Microwave Materials ***Description:*** Develop materials and processing technologies for power generation and control, and microwave components for surveillance, tracking, targeting, situational awareness, and lethal and non-lethal systems. ***FY 2012 Accomplishments:*** Developed and validated characterization and modeling tools to analyze material changes that occur at the nanoscale within an operating device. Developed and demonstrated reliable materials and processes to optimize components for compact, lightweight, high power microwave directed energy applications. Continued to develop nanostructured materials using multiple approaches for high energy density capacitors for pulsed power applications. ***FY 2013 Plans:*** Continue to develop and demonstrate reliable materials and processes to optimize components for compact, lightweight, high power microwave directed energy applications. Develop materials and processes for Polymeric Energy Conversion. ***FY 2014 Plans:*** Continue to develop and demonstrate reliable materials and processes to optimize components for compact, lightweight, directed energy applications. Continue to develop materials and processes for Polymeric Energy Conversion.	5.610	3.701	4.000
Title: Biomaterials ***Description:*** Develop enabling and foundational biotechnologies for guidance and control, rapid tagging, tracking, and identification of targets, and bio-integrated electronics and sensing. ***FY 2012 Accomplishments:*** Developed bio-materials and nano-based and functionalized materials for tagging, tracking, and locating applications. Developed biological engineering methods for sensors and electro-optic devices for complex hybrid materials. Developed bio-materials and nano-materials that enable broad spectrum mitigation of environmental threats. ***FY 2013 Plans:*** Continue to develop biological engineering methods for sensors and electro-optic devices for complex hybrid materials. Use pervasive computational materials science to model guided experiments and to enable rapid in-situ experimental data acquisition. ***FY 2014 Plans:***	4.328	1.177	1.500

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to develop and demonstrate biological engineering methods for sensors and electro-optic devices for complex hybrid materials. Use pervasive computational materials science to model guided experiments and to enable rapid in-situ experimental data acquisition.			
Title: High Energy Laser Materials ***Description:*** Develop materials enabling higher performance lasing media, new laser architectures, optical isolators, beam steering, and other high energy laser components for directed energy. ***FY 2012 Accomplishments:*** Developed materials for enabling improved laser source components operating in the mid-infrared range. Continued to develop materials processes for fabricating new laser beam scanning architectures that utilize the latest generation of electro-optic (EO) polymers to enable the high-speed beam steering. Developed and demonstrate materials that increase high energy laser efficiency and gain. ***FY 2013 Plans:*** Demonstrate materials for improved laser source components operating in the mid-infrared range. Develop materials with tailorable properties for beam steering in the newly accessible W band. Demonstrate materials processes for fabricating new laser beam scanning devices that utilize electro-optic polymers to enable high-speed beam steering. Develop and demonstrate materials that increase high energy laser efficiency and output. Utilize computational materials science to improve performance predictions and shorten design cycle time. ***FY 2014 Plans:*** Continue to demonstrate materials for improved laser source components operating in the mid-infrared range. Continue to develop materials with tailorable properties for beam steering in the newly accessible W band. Continue to demonstrate materials processes for fabricating new laser beam scanning devices that utilize electrooptic polymers to enable high-speed beam steering. Continue to develop and demonstrate materials that increase high energy laser efficiency and output. Utilize computational materials science to improve performance predictions and shorten design cycle time.	3.056	2.747	2.979
Accomplishments/Planned Programs Subtotals	30.017	28.805	30.302

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Applicable.

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E. Performance Metrics

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

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COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
624349: *Materials Technology for Sustainment*	-	19.785	26.897	26.163	-	26.163	32.843	33.209	32.169	32.780	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Sensing Technologies	7.153	12.487	12.109
Description: Develop sensing and life prediction technologies to identify damage and characterize the health of aging structures, propulsion systems, and low-observable (LO) materials and structures. ***FY 2012 Accomplishments:*** Advanced novel sensing modeling, methods, and techniques to detect and track damage to other materials and components for aerospace systems. Conducted applied research to enhance sensing through multiple layers of skin and structures to improve the probabilities of finding deeply imbedded or hidden damage in aerospace systems. Advanced sensing technologies that detect changes in material properties, damage evolution, and other factors that detrimentally affect aerospace systems. Developed and improved affordable prognosis approaches for life cycle management and life extension capability for aerospace structure and turbine engines. Investigated and augmented innovative LO point inspection probes to enable rapid assessment of LO material performance. ***FY 2013 Plans:*** Continue to conduct applied research to enhance sensing through multiple layers of materials and structures to improve the probabilities of finding deeply imbedded or hidden damage in aerospace systems. Advance sensing technologies to detect and characterize changes in material properties, damage evolution, and other factors that detrimentally affect aerospace systems. Demonstrate design assessment of reliability of affordable prognosis approaches to life cycle management and life extension for			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
aerospace structures and turbine engines. Continue to develop innovative LO point inspection probes to enable rapid assessment of LO material performance. Initiate research to assess metals performance in aerospace systems. ***FY 2014 Plans:*** Validate and demonstrate sensing through multiple layers of materials and structures to improve the probabilities of finding deeply imbedded or hidden damage in aerospace systems. Continue developing advanced sensing technologies to detect and characterize changes in material properties, damage evolution, and other factors that detrimentally affect aerospace systems. Validate design assessment of reliability of affordable prognosis approaches to life cycle management and life extension for aerospace structures and turbine engines. Validate functionality of innovative LO point inspection probes to enable rapid assessment of LO material performance. Continue research to asses metals performance in aerospace systems.			
Title: Production and Repair Technologies ***Description:*** Develop support capabilities, information, and processes to resolve problems with materials in the production and repair of systems components and structures. ***FY 2012 Accomplishments:*** Evaluated advanced materials and processes technology to repair Air Force legacy systems and tested failure limits for emerging Air Force systems. Developed and demonstrated test methods and techniques to understand the effects of in-service environments, residual stress and materials processes on structural materials, and to support studies and point design solutions that will extend the life of specific structural components on Air Force systems. Demonstrated and transitioned technologies for improved maintainability and life cycle cost of advanced materials and designs, such as conductive outer-moldline, aircraft films, coatings, access panel treatments, and multifunctional systems. Extruded access panel treatments and rain erosion tape evaluation for edge repair demonstrated on 5th Generation Air Force fighter aircraft. Developed and demonstrated laboratory test methods to evaluate and characterize candidate space materials for properties and material behavior suitable for use in space applications. ***FY 2013 Plans:*** Continue to evaluate advanced materials and processes technology to repair Air Force legacy systems. Investigate failure limits for emerging Air Force systems. Develop test methods and techniques to understand effects of service environments, corrosion, residual stresses, and material processes on structural materials. Conduct studies and support designs that will extend the life of specific structural components on Air Force systems. Transition advanced materials technologies and designs for improved maintainability and life cycle cost of conductive outer-moldline films, coatings, access panel treatments, and multifunctional systems. Initiate development of lab test methods and models to understand and evaluate material degradation and corrosion in	5.788	4.370	4.054

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
built-up aircraft structures. Use computational materials science to perform 3D analysis to predict and analyze material boundary conditions. ***FY 2014 Plans:*** Validate and demonstrate advanced materials and processes technology to repair Air Force legacy systems. Continue to investigate failure limits for emerging Air Force systems. Continue to validate and demonstrate test methods and techniques to understand effects of service environments, residual stresses, and material processes on structural materials. Continue to conduct studies and support designs that will extend the life of specific structural components on Air Force systems. Continue to transition advanced materials technologies and designs for improved maintainability and life cycle cost of conductive outer-moldline films, coatings, access panel treatments, and multifunctional systems. Develop improved lab test methods and models to understand and evaluate material degradation and corrosion in built-up aircraft structures. Continue developing techniques for using computational materials science to perform 3D analysis to predict and analyze material boundary conditions.			
Title: Failure Analysis Technologies ***Description:*** Develop support capabilities, information, and processes to resolve materials problems and provide electronic and structural failure analysis of components. ***FY 2012 Accomplishments:*** Performed quick response failure analysis and materials investigations. Determined root cause and recommended corrective actions for multiple electrical and structural mishap/failures. Provided advanced materials solutions to ensure system availability and safety of flight. Initiated development of Microelectromechanical System (MEMS) failure analysis capabilities. Developed advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Demonstrated advanced test methodologies for analyzing electrical and structural failures of emerging materials. Transitioned Computed Radiography for all applications except weld inspections to minimize cost, inspection time, and use of environmentally hazardous materials. Developed advanced wiring materials technologies to replace aging wiring systems and new wiring technologies for emerging weapon systems. Defined new aging test criteria in assessing Air Force wiring insulation materials. ***FY 2013 Plans:*** Continue to perform quick response failure analyses and materials investigations. Continue to provide advanced materials solutions to ensure critical warfighter system availability and safety of flight. Continue development of MEMS failure analysis capabilities. Validate advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Transition advanced test methods for analyzing electrical and structural failures of emerging materials. Validate test criteria and demonstrate advanced wiring materials technologies to replace aging wiring systems. Demonstrate new wiring technologies for emerging weapon systems. ***FY 2014 Plans:***	6.844	10.040	10.000

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APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602102F: *Materials*	PROJECT 624349: *Materials Technology for Sustainment*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to perform quick response failure analyses and materials investigations. Initiate investigation of improved analysis techniques to determine root cause materials failure/degradation. Continue to provide advanced materials solutions to ensure critical warfighter system availability and safety of flight. Continue development of MEMS failure analysis capabilities. Continue to validate advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Continue to transition advanced test methods for analyzing electrical and structural failures of emerging materials. Continue to validate and demonstrate advanced wiring materials technologies to replace aging wiring systems. Continue to validate and demonstrate new wiring technologies for emerging weapon systems.			
Accomplishments/Planned Programs Subtotals	19.785	26.897	26.163

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602102F: *Materials*	PROJECT 624915: *Deployed Air Base Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
624915: *Deployed Air Base Technology*	-	3.791	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Infrastructure Technologies	1.923	0.000	0.000
Description: Develop deployable infrastructure airbase technologies to reduce airlift and manpower requirements, setup times, and sustainment costs in support of AEF operations. ***FY 2012 Accomplishments:*** Investigated and developed innovative airbase alternative energy generation capability, power grid conditioning, and distribution methods. Explored and continued development of high operating temperature materials and technologies for aircraft operating surfaces. ***FY 2013 Plans:*** Work completed in FY12. Future work in this area transitioned to the Air Force Civil Engineering Center. ***FY 2014 Plans:*** N/A			
Title: Force Protection Technologies	1.868	0.000	0.000
Description: Develop affordable technologies to provide force protection and survivability to AEF deployed warfighters and infrastructure. ***FY 2012 Accomplishments:***			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602102F: *Materials*	PROJECT 624915: *Deployed Air Base Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Developed technologies for airbase structural protection against blast and fragmentation. Explored technology to enhance structural integrity. Investigated composite material combustion processes and developed modeling for aircraft fires. Developed innovatve technologies for airbase fire fighting. ***FY 2013 Plans:*** Work completed in FY12. Future work in this area transitioned to the Air Force Civil Engineering Center. ***FY 2014 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	3.791	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*					R-1 ITEM NOMENCLATURE PE 0602201F: *Aerospace Vehicle Technologies*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	145.392	120.719	119.672	-	119.672	121.849	123.393	125.530	129.925	Continuing	Continuing
622401: *Structures*	-	46.275	42.021	44.062	-	44.062	45.656	49.595	51.954	54.528	Continuing	Continuing
622403: *Flight Controls and Pilot-Vehicle Interface*	-	38.992	36.189	35.238	-	35.238	34.081	34.508	32.710	33.341	Continuing	Continuing
622404: *Aeromechanics and Integration*	-	60.125	42.509	40.372	-	40.372	42.112	39.290	40.866	42.056	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 analyses. Resulting technologies improve performance of existing and future manned and remotely piloted air and space access vehicles. Improvements include, but are not limited to, reduced energy use by efficient air platform designs, use of lightweight composite structures and improved sustainment methods based on the condition of the platform and sub-systems. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. 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.

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	147.628	120.719	128.975	-	128.975
Current President's Budget	145.392	120.719	119.672	-	119.672
Total Adjustments	-2.236	0.000	-9.303	-	-9.303
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	0.399	0.000			
• SBIR/STTR Transfer	-2.635	0.000			
• Other Adjustments	0.000	0.000	-9.303	-	-9.303

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602201F: *Aerospace Vehicle Technologies*

Change Summary Explanation

Decrease in FY 2014 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602201F: *Aerospace Vehicle Technologies*	PROJECT 622401: *Structures*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
622401: *Structures*	-	46.275	42.021	44.062	-	44.062	45.656	49.595	51.954	54.528	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops advanced structures concepts to exploit new materials and fabrication processes and investigates new concepts and design techniques. New structural concepts include incorporating subsytem hardware items and adaptive mechanisms into the aerospace structures and/or skin of the platform.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Service Life Technologies	19.763	24.502	28.476
Description: Develop an economic service life analysis capability comprised of analysis tools, methodologies, and structural health monitoring schemes. ***FY 2012 Accomplishments:*** Continued the technology development of integrated sensors for determination of system health. Incorporated newly developed analysis tools. Continued the technology development of failure criteria tools for advanced high temperature aircraft components and concepts. Initiated technology efforts for condition-based maintenance of structural integrity. ***FY 2013 Plans:*** Continue development of engineered residual stress concepts, analysis, and applications. Continue the development concepts for risk informed decision-making. Continue efforts for condition-based maintenance of structural integrity. Complete the development of integrated sensors for determination of system health. Continue the development of failure criteria tools for advanced aircraft components and concepts. Initiate efforts in certification of advanced composite for aircraft structures. ***FY 2014 Plans:*** Complete development of engineered residual stress concepts, analysis, and applications. Continue the technology development concepts for risk informed decision-making. Continue technology efforts for condition-based maintenance of structural integrity. Continue the technology development of failure criteria tools for advanced aircraft components and concepts. Begin efforts to certify, verify and validate, and test advanced composite technologies for aircraft structures.			
Title: Airworthiness Certification Technologies	6.897	3.075	2.641
Description: Develop methodologies to reduce the cost and time involved in actual full-scale testing of components and aircraft prior to obtaining airworthiness certification.			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602201F: *Aerospace Vehicle Technologies*	PROJECT 622401: *Structures*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Continued development of methodologies that will allow for lower cost analytical certification of advanced composite structures. Initiated experimental validation of integrated system health management technologies for aircraft subsystems. Initiated the development of advanced aircraft flutter analysis tools. ***FY 2013 Plans:*** Continue development of multi-disciplinary methodologies that will allow for lower cost analytical certification of advanced composite structures. Complete experimental validation of integrated system health management technologies for aircraft subsystems. Continue the development of advanced aircraft flutter analysis tools. ***FY 2014 Plans:*** Continue development of multi-disciplinary methodologies that will allow for lower cost analytical certification of advanced designed structure. Continue the development of advanced aircraft flutter analysis tools.			
Title: Survivability and Performance Technologies ***Description:*** Develop design methods to capitalize on new materials, multi-role considerations, and technology integration of various subsystem hardware items and adaptive mechanisms into aircraft systems. ***FY 2012 Accomplishments:*** Continued the development of low-cost technologies to increase the survivability and performance of future systems. Developed and demonstrated system level thermal management concepts to meet the need of multi-function, multi-role, and adaptive aircraft. ***FY 2013 Plans:*** Continue the development of low-cost technologies to increase the survivability and performance of future systems. Decrease in FY 2013 due to higher Department of Defense priorities. ***FY 2014 Plans:*** Continue the development of low-cost technologies to increase the survivability and performance of future systems. Initiate efforts on energy efficient integration of conformal load bearing antenna technologies.	7.725	2.366	2.705
Title: Extreme Flight Environment Technologies ***Description:*** Develop technologies that will permit the structural development of platforms that can operate at an extreme altitude, while at sustained speeds greater than Mach 2. ***FY 2012 Accomplishments:***	11.890	12.078	10.240

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602201F: *Aerospace Vehicle Technologies*	PROJECT 622401: *Structures*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Furthered the development of technologies for integrated air vehicle structures that can withstand extreme flight environments, incorporating advanced materials and design concepts. Initiated development of structural concepts and analysis methods for design and evaluation of hot primary structure. Continued to refine reusable and affordable space access concepts and apply these technologies for lower cost, reduced weight expendable vehicle airframes. ***FY 2013 Plans:*** Further develop technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Continue to develop structural concepts and analysis methods for design and evaluation of hot primary structure. Complete the refinement of affordable space access concepts and apply these technologies for lower cost, reduced weight expendable vehicle airframes. ***FY 2014 Plans:*** Continue to develop structural design concepts that incorporate promising materials and components for the creation of an integrated vehicle structure that can withstand extreme flight environments. Validate extreme environment prediction methods to develop key hot structure design data. Further development of analytical methods for predicting structural response needed for design and evaluation of hot primary structure for hypersonic vehicles.			
Accomplishments/Planned Programs Subtotals	46.275	42.021	44.062

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602201F: *Aerospace Vehicle Technologies*	PROJECT 622403: *Flight Controls and Pilot-Vehicle Interface*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
622403: *Flight Controls and Pilot-Vehicle Interface*	-	38.992	36.189	35.238	-	35.238	34.081	34.508	32.710	33.341	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops technologies that enable maximum affordable capability from manned and remotely piloted 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 remotely piloted air vehicles, space access systems with aircraft-like operations, and extended-life legacy aircraft.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Single Aircraft Advanced Flight Controls Technologies	9.642	16.304	14.902
Description: Develop technologies for advanced flight control systems, components, and integrated vehicle monitoring systems for both manned and remotely piloted aircraft. ***FY 2012 Accomplishments:*** Furthered the development of advanced control mechanization technologies to provide highly reliable operations for aerospace systems under adverse environments. Refined technology development of control architecture enhancements for remotely piloted systems. ***FY 2013 Plans:*** Further the development, assessment, and certification capability of advanced flight control mechanization technologies for highly reliable operations under adverse environments. Continue development of control configurations for small remotely piloted aerospace systems. Continue development of control systems hardening and health assessment technologies for enhanced survivability. ***FY 2014 Plans:*** Further the development, demonstration, and assessment of advanced flight control mechanization technologies for trusted and certifiable operations under adverse and contested environments. Continue development of control configurations for small remotely piloted aerospace systems. Continue development of survivable and health-adaptive control system architectures.			
Title: Multiple Aircraft Advanced Flight Controls Technologies	13.505	12.942	14.058

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602201F: *Aerospace Vehicle Technologies*	PROJECT 622403: *Flight Controls and Pilot-Vehicle Interface*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: Develop technology for flight control systems that will permit safe interoperability between manned and remotely piloted aircraft. ***FY 2012 Accomplishments:*** Continued performance analysis of mixed-initiative control of multiple remotely piloted aircraft packages. Refined the development and assessment of adaptive guidance and control technologies for fault/damage tolerance and rapid flight planning of aerospace vehicle operations. ***FY 2013 Plans:*** Further the development and assessment of advanced control automation techniques. Continue the development of mixed initiative control techniques for multiple remotely piloted aircraft teams, as well as for the integration of unmanned systems into controlled airspace and airbase operations. Continue the development and assessment of adaptive guidance and control technologies for fault/damage tolerance. ***FY 2014 Plans:*** Further the development, demonstration, and assessment of advanced control automation techniques. Continue the development of mixed initiative control techniques for multiple remotely piloted aircraft teams in dynamic mission environments, as well as for the integration of unmanned systems into controlled airspace and airbase operations. Complete the assessment of adaptive guidance and control technologies for fault/damage tolerance in unmanned space access systems.			
Title: Flight Controls Technologies Modeling and Simulation ***Description:*** Develop tools and methods for capitalizing on simulation-based research and development of future aerospace vehicles. ***FY 2012 Accomplishments:*** Conducted simulation events to evaluate emerging flight control technologies and concepts. Refined technology trade studies of remotely piloted air vehicles in manned/remotely piloted airspace and airbase operations. Refined trade studies of vehicle concepts for strike, mobility and reconnaissance. ***FY 2013 Plans:*** Continue to conduct modeling and simulation efforts to evaluate emerging flight control technologies and concepts, as well as assess mission-level performance of integrated air systems. Continue technology analyses of unmanned air systems in manned/unmanned airspace and airbase operations. Refine trade studies of vehicle concepts for strike, mobility and reconnaissance. ***FY 2014 Plans:***	15.845	6.943	6.278

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602201F: *Aerospace Vehicle Technologies*	PROJECT 622403: *Flight Controls and Pilot-Vehicle Interface*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue modeling and simulation efforts to evaluate emerging autonomous and survivable flight control technologies and concepts, as well as assess mission-level performance of integrated aerospace systems. Continue analyses of automated unmanned air systems in controlled airspace and airbase operations, as well as in adversarial mission environments. Continue trade studies of vehicle concepts for strike, mobility and reconnaissance.			
Accomplishments/Planned Programs Subtotals	38.992	36.189	35.238

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602201F: *Aerospace Vehicle Technologies*	PROJECT 622404: *Aeromechanics and Integration*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
622404: *Aeromechanics and Integration*	-	60.125	42.509	40.372	-	40.372	42.112	39.290	40.866	42.056	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Aeronautical Technologies for Unmanned Aircraft	3.517	10.550	8.634
Description: Develop aerodynamic prediction efforts centered on expanding the design capabilities of manned and remotely piloted aircraft. ***FY 2012 Accomplishments:*** Developed and assessed aeronautical technologies that enable broad use of unmanned aircraft. Continued work to develop and demonstrate flow control to enable fluidic thrust vectoring, area control, and thermal management for a remotely piloted aircraft exhaust nozzle. Continued development of innovative aerodynamic control methods for small remotely piloted aircraft. ***FY 2013 Plans:*** Continue to develop and assess aeronautical technologies that enable broad use of unmanned aircraft. Continue work to develop and demonstrate flow control to enable unsteady load suppression, fluidic thrust vectoring, area control, and thermal management for a remotely piloted aircraft. Continue development of innovative aerodynamic control methods for remotely piloted aircraft. ***FY 2014 Plans:*** Continue to develop and assess aeronautical technologies that enable broad use of unmanned aircraft. Complete demonstration of flow control techniques to enable unsteady load suppression for unmanned ISR platforms and future fleet mobility aircraft to increase aerodynamic efficiency. Continue development of innovative aerodynamic control methods for integrating high bypass propulsion for unmanned ISR platforms and future mobility aircraft.			
Title: Concepts, Designs, and Analysis of High Speed Technologies	26.538	7.576	8.511

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602201F: *Aerospace Vehicle Technologies*	PROJECT 622404: *Aeromechanics and Integration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: Develop new and improved concepts, designs, and analysis of technologies to enable revolutionary capabilities for sustained high-speed re-useable high altitude vehicle efforts. ***FY 2012 Accomplishments:*** Continued development of analysis/design techniques and tools to enable shock/boundary layer interaction flow control and enhanced stability for high-speed propulsion concepts. Characterized high-speed phenomena and continued to develop and validate fundamental high-speed component technologies through experimental flight techniques in a relevant environment. ***FY 2013 Plans:*** Continue to develop technologies to enable high-speed flight. Continue development of analysis/design techniques and tools to enable shock/boundary layer interaction flow control and enhanced stability for high-speed propulsion concepts. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through experimental flight techniques in a relevant environment. ***FY 2014 Plans:*** Continue to develop technologies to enable high-speed flight. Continue development of analysis/design techniques and tools to enable shock/boundary layer interaction flow control and enhanced stability for high-speed propulsion concepts. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through experimental testing in a relevant environment.			
Title: Directed Energy Weapons Integration Technologies ***Description:*** Develop enabling technologies to allow integration of directed energy weapons into current and future air vehicle platforms. ***FY 2012 Accomplishments:*** Continued work to apply advanced analysis tools to predict the performance of flow control and adaptive optics systems for problems of interest to the Air Force. Extended development of analysis tools for prediction of advanced flow control and adaptive optics to higher speed transonic/supersonic flows. ***FY 2013 Plans:*** N/A. ***FY 2014 Plans:*** N/A.	2.534	0.000	0.000
Title: Next Generation Multi-Role Large Aircraft Technologies	27.536	24.383	23.227

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602201F: *Aerospace Vehicle Technologies*	PROJECT 622404: *Aeromechanics and Integration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: Develop and assess technologies for the next generation of multi-role large aircraft. ***FY 2012 Accomplishments:*** Continued to develop technologies that enable multiple roles and missions for delivery and support aircraft. Conducted wind tunnel experiments to show the feasibility of mobility aircraft using 40% less energy through the use of natural and artificial laminar boundary layers, alternative fuels, and very high bypass propulsion integration. ***FY 2013 Plans:*** Continue to develop aerodynamic and propulsion integration technologies that enable multiple roles and missions for delivery and support aircraft. Conduct analyses and experiments to investigate flow control for suppression of unsteady flow and enhanced drag reduction, and to enhance platform performance with integrated propulsion. ***FY 2014 Plans:*** Continue to develop aerodynamic and propulsion integration technologies that enable multiple roles and missions for delivery and support aircraft. Continue analyses and experiments to investigate flow control for suppression of unsteady flow and enhanced drag reduction, and to enhance platform performance with integrated propulsion. Begin studies investigating more extensive legacy fleet fuel savings opportunities. Extend swept wing laminar flow to higher Reynolds numbers.			
Accomplishments/Planned Programs Subtotals	60.125	42.509	40.372

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*					R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	93.034	89.319	89.483	-	89.483	94.584	99.553	102.529	101.686	Continuing	Continuing
621123: *Learning and Operational Readiness*	-	17.790	13.517	14.480	-	14.480	16.617	18.086	20.913	18.448	Continuing	Continuing
625328: *Human Dynamics Evaluation*	-	20.955	22.467	23.304	-	23.304	24.640	27.167	26.511	27.013	Continuing	Continuing
625329: *Sensory Evaluation and Decision Science*	-	29.118	32.037	28.861	-	28.861	30.192	30.038	30.339	30.964	Continuing	Continuing
627184: *Performance Evaluation in Extreme Environments*	-	3.413	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
627757: *Bioeffects*	-	21.758	21.298	22.838	-	22.838	23.135	24.262	24.766	25.261	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program conducts applied research in the area of airmen training, airmen system interfaces, bioeffects, deployment and sustainment of airmen in extreme environments, and understanding and shaping adversarial behavior. The Learning and Operational Readiness 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 remotely piloted aircraft (RPA) 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 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. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. 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 2014 Air Force					DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*			R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*		
B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	86.663	89.319	92.192	-	92.192
Current President's Budget	93.034	89.319	89.483	-	89.483
Total Adjustments	6.371	0.000	-2.709	-	-2.709
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	7.223	0.000			
• SBIR/STTR Transfer	-0.852	0.000			
• Other Adjustments	0.000	0.000	-2.709	-	-2.709

Change Summary Explanation

Decrease in FY 2014 is due to higher DoD priorities.

Reprogrammed for specific projects in accordance with Section 219 of the Duncan Hunter National Defense Authorization Act for Fiscal Year (FY) 2009, as amended by Section 2801 of the National Defense Authorization Act for FY 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 621123: *Learning and Operational Readiness*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
621123: *Learning and Operational Readiness*	-	17.790	13.517	14.480	-	14.480	16.617	18.086	20.913	18.448	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 two focus areas: continuous learning and aiding and cognitive and behavioral modeling. The continuous learning and aiding effort creates live, virtual, and constructive (LVC) environments for use in developing revolutionary simulation technologies to increase training capabilities and enhance 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Continuous Learning	12.634	10.027	10.315
Description: Research enhances Distributed Mission Operations (DMO) and LVC environments and identifies technology requirements for training in live and immersive environments. Continuous learning/aiding strategies improve mission training, command and control (C2), intelligence, surveillance, and reconnaissance (ISR), and cyber missions.			
FY 2012 Accomplishments: Investigated technologies that enable accurate training across multiple security levels in LVC environments. Developed common tools to define scenario and content compatible with different training and operational environments. Completed validation of fidelity analysis methods and models for use in identifying alternative training and operational environment characteristics. Developed learning management tools for use in LVC contexts. Demonstrated mission performance-based after action review tools. Identified key requirements for RPA personnel training. Demonstrated persistent training and operations event tracking for individual and small team proficiency and squadron readiness assessment.			
FY 2013 Plans: Develop methods to manage mission performance data across LVC contexts. Develop technology solution tools to monitor the credibility of virtual and constructive players to augment live operational training and rehearsal. Integrate manned and unmanned DMO systems in common training scenarios. Develop scenarios for cyber team training in a Red Flag exercise environment. Develop after action review and analysis tools for C2, ISR, and cyber team training.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 621123: *Learning and Operational Readiness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Extend methodologies for managing learning and performance to apply across combat operations, tactical C2 and ISR teams in LVC environments. Initiate evaluations of technologies required for a complementary family of trainers. Evaluate rule-sets for training across multiple security levels in LVC environments. Evaluate scenarios for integrated C2/ISR/cyber team training in a Red Flag exercise environment.			
Title: Cognitive Modeling ***Description:*** Research explores application of cognitive science for performance improvement by enhancing training in mission-relevant environments (e.g., flight simulators). ***FY 2012 Accomplishments:*** Improved human behavior representation in synthetic teammates by incorporating prediction intervals, an enhanced knowledge base, and decision heuristics. ***FY 2013 Plans:*** Identify and validate mechanisms to explain and predict human cognitive performance. Develop technologies that facilitate optimized model development for applications/synthetic entities that are complex, dynamic, and require orders of magnitude more knowledge than traditional cognitive models for laboratory tasks. Investigate math models of skill acquisition and vigilance as they relate to mission tasks for, but not limited to, ISR analysts, RPA operators, and pilots. ***FY 2014 Plans:*** Complete predictive performance optimization for cognitively valid readiness tracking in Air Force training. Initiate research in mechanisms of human knowledge learning and seeking and their interaction. Validate the ability of a first generation synthetic teammate to perform effectively in a team environment.	5.156	3.490	4.165
Accomplishments/Planned Programs Subtotals	17.790	13.517	14.480

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625328: *Human Dynamics Evaluation*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
625328: *Human Dynamics Evaluation*	-	20.955	22.467	23.304	-	23.304	24.640	27.167	26.511	27.013	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Note: In FY 2013, Measurement and Signature Intelligence (MASINT) moves from Project 627184 to Thrust 4 in this Project to better align the efforts.

A. Mission Description and Budget Item Justification

This project conducts applied research to advance machine intelligence, information operations, and operator-aiding technologies for advanced intelligence, surveillance, and reconnaissance (ISR) capabilities. It develops and applies science and technology to detect and exploit a variety of human-centered signatures, including behavioral, nano-, bio-, and molecular aspects of existing and emerging adversaries. Research is focused in the following areas: human analyst augmentation, human trust and interaction, and human signatures. The human analyst augmentation area develops, integrates, and evaluates human-centric analyst technology solutions, such as adversarial modeling and cross-cultural communication, leading to more operationally effective ISR for the Air Force. The human trust and interaction area studies relevant human threat and vulnerability patterns in the context of everyday life and seeks to understand human interaction with autonomous systems. The human signatures area discovers, characterizes, and integrates signature information to enable rapid and accurate human MASINT.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Enhance Human Cyber Operations	1.888	0.000	0.000
Description: Identify methods to enhance mission-essential human capabilities for cyber operations. Develop measures of effectiveness for cyber capabilities. ***FY 2012 Accomplishments:*** Conducted research into enhancing cognitive cyber performance. Developed technologies that increase situational awareness within cyber operations and researched metrics to accurately assess attacks from adversaries. ***FY 2013 Plans:*** Effort completed in FY 2012. ***FY 2014 Plans:*** N/A			
Title: Human Analyst Augmentation	4.061	3.075	5.668

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625328: *Human Dynamics Evaluation*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: Conduct research to enhance human components of ISR. Develop ability to anticipate, influence, and dominate adversary's air, space, and cyber ISR systems, processes, and organizations. ***FY 2012 Accomplishments:*** Developed framework and knowledge-based foundation for intelligence analysis. Conducted studies and incorporated feedback from the intelligence community to enhance methodologies for exploiting unstructured and cognitively complex data and information. ***FY 2013 Plans:*** Develop new multi-intelligence analysis concepts and prototypes based upon analyst evaluations. Conduct studies to evaluate new prototypes for signatures, patterns, and other exploited intelligence data to augment analysis effectiveness. ***FY 2014 Plans:*** Expand multi-intelligence analysis prototypes to include autonomous systems and human performance augmentation technologies. Provide robust situation awareness to enhance decision-makers' understanding and knowledge by improving ISR capabilities and data processing, exploitation, and dissemination.			
Title: Human Trust and Interaction ***Description:*** Conduct research to develop technology base for anticipatory C2 intelligence decision support. Conduct research in cross-cultural communications and automated speech translation tools for Air Force missions. Develop models/metrics to predict/ evaluate organizational effectiveness alignment and collaboration readiness. ***FY 2012 Accomplishments:*** Developed methods to enhance an analyst's ability to assess possible threats as a logical consequence of observed human and organizational behavior. Began integration of cognitive modeling architectures and cultural modeling techniques to initiate framework for estimating adversary intent and possible courses of action. Researched foreign language speech-to-speech translation applications that support automated, cross-cultural communications. Refined and expanded advanced, automated algorithms for measures of effectiveness analyses supporting improved influence operations capabilities. Developed methods applicable to theaters of operation that enhance warfighter situational awareness of adversarial location, intent, and predictability of hostile action. Developed decision aid concepts to exploit operator trust between people and trust of automation. Conducted trust-based experimentation, discourse analysis and built vulnerability modeling tools. Completed organizational vulnerabilities research; illustrated and documented modes/simulations that will show the impact of improved work design, engaged organizational culture and enhanced collaboration readiness. ***FY 2013 Plans:***	9.280	9.524	9.306

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625328: *Human Dynamics Evaluation*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Explore multicultural potential avenues of influence and develop adversary effects models and simulations. Develop tools, algorithms, and techniques for rapid development of speech recognition, machine translation, and natural language processing components in new languages and domains. Develop methods for speech recognition and translation of previously unencountered words in languages that have complex prefix and suffix structures in order to improve threat warning. Explore methods and develop theories for quantification of trust between people and real-time metrics of human trust of automation. ***FY 2014 Plans:*** Mature speech recognition and machine translation capabilities for new languages and domains. Assess speech recognition and machine translation technologies against data sets representative of general ISR applications. Investigate how to adapt these algorithms to evolving contexts such as changing topics. Investigate strategies and methodologies for combing multiple algorithms simultaneously to optimize system performance.			
Title: Human Signatures ***Description:*** Develop databases of human motion and features collected from air/space platforms. Identify human threat signatures across diverse populations for ISR and force protection applications. Conduct surveillance and counterproliferation research to support detection, identification, and assessment of threat agents in support of Air Force operational missions. ***FY 2012 Accomplishments:*** Initiated 3-D human activity replication using 3-D human models. Developed a human motion repository to identify human threat and performance signatures. Developed tools for image analyst training that identify and visualize critical threat indicating signatures. ***FY 2013 Plans:*** Develop architectures for machine-intelligent biofidelic human threat models. Develop human motion/shape information system and online analytic tools for automatic detection and tracking of humans, discernment of gender, and detection of human shape anomalies. Develop nano-bio technologies and sensor components to detect target molecules of interest in the operational environment. Develop analysis tools to identify and track molecular-based threat signatures. Characterize and exploit human signatures to perform ISR mission tagging, tracking, and locating of threats. ***FY 2014 Plans:*** Develop tools for the ISR analyst and special operations forces to detect and characterize human signatures in multiple sensing modalities from multiple platforms for human threat situational awareness. Develop tools for ISR applications to detect and characterize molecular signatures for increased threat detection in an operational environment.	5.726	9.868	8.330
Accomplishments/Planned Programs Subtotals	20.955	22.467	23.304

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625328: *Human Dynamics Evaluation*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625329: *Sensory Evaluation and Decision Science*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
625329: *Sensory Evaluation and Decision Science*	-	29.118	32.037	28.861	-	28.861	30.192	30.038	30.339	30.964	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project conducts applied research to revolutionize the manner in which the human optimizes the capabilities of Air Force systems, including RPA and adaptive teams of humans and machines. Research optimizes human situational awareness and cognitive performance, 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: applied neuroscience; human role in semiautonomous systems; battlespace visualization; and battlespace acoustics. The applied neuroscience area develops technologies to enhance human-human and human-machine collaborations and system interactions in distributed decision-making environments. The human role in semiautonomous systems area develops new control/display concepts and technologies to optimize Air Force 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Applied Neuroscience	10.805	9.887	10.133
Description: Develops technologies to enhance human performance, human-human and human-machine collaboration, and system interaction in distributed decision-making environments. Predicts physiological impacts of high-stress/extreme environments.			
FY 2012 Accomplishments: Developed team functional state assessment criteria and characterized context dependent methodologies for assessing the cognitive functional state of teams. Explored algorithm utility for assessing real-time team functional state in distributed operations. Evaluated ability to capture team functional state assessments to enhance collaboration and team decision-making. Developed adaptive interface algorithms for operator decision aiding. Defined stressor-influenced mechanisms for developing strategies to optimize cognitive readiness and to influence performance in theater. Targeted specific biological, behavioral, and physical metrics and markers for defining mechanisms that improve cognitive performance.			
FY 2013 Plans: Explore the development of trust metrics that can be used to design and enable trust automation for operators. Develop the framework for modeling physiological and behavioral workload on the human operator. Develop adaptive algorithms for workload			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625329: *Sensory Evaluation and Decision Science*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
management and mitigation. Evaluate utility of workload assessment tool for teams. Investigate potential tools for enhancing warfighter cognitive resiliency and performance through the manipulation of intrinsic biological and physiological mechanisms and processes. Define metrics and biomarkers of resiliency and performance that can be integrated into these tools for sensing and assessing cognitive state. Develop physiology modeling and sensing capability to measure stress parameters and predict physiological impacts of high-stress/extreme environments. ***FY 2014 Plans:*** Begin examining new sense, assess, and augmentation technologies to provide adaptive aiding based on warfighter performance. Validate team workload and trust measures to enhance effective human-human and human-machine system performance. Define team synchronicity and cognitive functional state metrics that aid team performance. Research stress-driven processes and their effects on human performance. Explore psychological and neurophysiological mechanisms and processes for developing unique operational strategies that enhance cognitive resiliency and performance. Continue to develop physiology models to predict the effects of high-stress/extreme environments on the human. Begin investigating interface technologies and exposure design criteria to protect operators and mitigate injury and performance risks. Begin development of on-board oxygen generating technologies to mitigate hypoxia vulnerability risks.			
Title: Human Role in Semiautonomous Systems ***Description:*** Research new control/display concepts and technologies (e.g., information portrayal, control devices, decision-aiding algorithms). Identify best design to direct operator attention. ***FY 2012 Accomplishments:*** Explored flexible automation techniques and transitions to enable a human operator to intervene at various levels with autonomous systems. Developed methods to quickly and easily ascertain the status/intent of complex automation. Designed and evaluated methods and interfaces to support distributed, ubiquitous unmanned system control of many heterogeneous systems. Investigated combined spatial and temporal displays for proactive management of multiple semiautonomous assets. ***FY 2013 Plans:*** Identify human operator-RPA automation interaction technologies and techniques that will provide increased situational awareness while exercising supervisory control of multiple RPAs. Investigate and develop course-of-action tools, displays, and system software architectures that will support an operator's choice between several courses of action. Explore the use of adaptive automation for teams of RPAs/RPA operators to enable real-time situational awareness of human and vehicle states. Develop an agent information architecture that responds to RPA pilot information queries by gathering, fusing and presenting information from on- and off-board sources. ***FY 2014 Plans:***	6.422	6.921	6.269

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625329: *Sensory Evaluation and Decision Science*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Investigate various automation technologies for the command and control of multiple RPAs. Examine the interplay between automation technologies and various tools to enable choices between courses of action. Evaluate advanced visualizations concepts and interaction methods for managing information from on-board and off-board sources to support RPA operator decision-making. Begin developing adjustable, adaptive levels of automation to support flexible control of unmanned systems depending on mission and environmental context.			
Title: Battlespace Visualization ***Description:*** Advances science and technology associated with collecting, optimizing, displaying, and assimilating sensory information to enhance warfighter decision-making. ***FY 2012 Accomplishments:*** Explored vision enhancement techniques for fusing multisource data to facilitate decision-making. Developed interactive visualizations for displaying and analyzing multisource information to improve situational awareness. Investigated visual analytics to optimally represent relevant information from large and disparate data sets. Developed initial visualizations to represent and analyze large amounts of data to increase human performance. ***FY 2013 Plans:*** Assess human perception and performance of fused, multisource information. Develop visualizations using visual analytics for representing information from large, disparate data sets. Extend visualization techniques to three-dimensional (3-D) displays. Assess the effectiveness of interactive visualizations to augment human operator situational awareness. ***FY 2014 Plans:*** Develop a suite of image enhancement and fusion tools based on human perception and performance. Begin the design and evaluation of visualizations based on visual analytics to represent and visualize relevant information from large, disparate data sets. Assess application of visual analytics to various warfighting domains. Evaluate the effectiveness of using 3-D displays to augment human decision-making and situational awareness. Evaluate the use of various interaction devices, when interacting with visualizations, to determine their effectiveness in aiding human performance.	6.281	8.306	8.156
Title: Battlespace Acoustics ***Description:*** Conducts research on advanced auditory and communication technologies that mitigate effects of noise and enhance performance in operational environments. ***FY 2012 Accomplishments:*** Explored the application of multi-modal digital communication technologies to enhance speech intelligibility, communication effectiveness, and situational awareness in communication-intense military environments. Explored the use of accelerated speech to enhance situational awareness and communication effectiveness. Assessed integration of graphical images with	5.610	6.923	4.303

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625329: *Sensory Evaluation and Decision Science*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
speech and text communication to enhance operator situational awareness and understanding. Evaluated and monitored operator stress and workload using verbal communication signals. ***FY 2013 Plans:*** Explore how best to use multi-modal and networked communications to fight through cyber attacks in defensive cyber operations with a focus on the human interface. Investigate human interface concepts that disrupt communication effectiveness across networked command and control teams for offensive cyber operations. Explore the use of advanced multi-modal interfaces to aid combat search and rescue teams in simulated scenarios. Assess the effectiveness of spatial audio display concepts combined with vibro-tactile displays and enhanced visual displays to augment individual and team performance. ***FY 2014 Plans:*** Develop auditory interfaces to enable the human operator to respond to cyber attacks. Develop interface concepts for using multi-modal displays and visualizations to support combat search and rescue teams. Examine the effectiveness of audio displays combined with multi-modal interaction techniques to support human operator decisionmaking.			
Accomplishments/Planned Programs Subtotals	29.118	32.037	28.861

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 627184: *Performance Evaluation in Extreme Environments*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
627184: *Performance Evaluation in Extreme Environments*	-	3.413	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project conducts applied research focused on biotechnology for the detection, identification, monitoring, and neutralization of biological threat agents.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Counterproliferation	3.413	0.000	0.000
Description: Conduct surveillance and counterproliferation research to support detection, identification, and assessment of threat agents in support of Air Force operational missions. ***FY 2012 Accomplishments:*** Developed and incorporated bioinspired nanoparticle taggants for enhanced warfighter counterproliferation capability during operational missions. Identified biological markers that indicate that individuals have handled, transported, or manipulated weapons of mass destruction. ***FY 2013 Plans:*** In FY 2013, the effort in this Project moves into Project 625328 to better align efforts. ***FY 2014 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	3.413	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 627184: *Performance Evaluation in Extreme Environments*

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 627757: *Bioeffects*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
627757: *Bioeffects*	-	21.758	21.298	22.838	-	22.838	23.135	24.262	24.766	25.261	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project conducts applied research on the effects of human exposure to nanomaterials, electromagnetic (EM) 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 molecular bioeffects. 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 investigates basic biological mechanisms of RFR, conducts theoretical and empirical dosimetry, conducts research of bioeffects from short- and long-term exposures, develops methods to counter RFR threats, and performs research for exploitation of directed energy systems for offensive capabilities. Molecular bioeffects research is conducted to protect airmen from the effects of toxic chemicals and materials and to monitor and enhance cognitive and physiological performance.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Optical Radiation Bioeffects	8.054	8.128	6.417
Description: Conduct laboratory experiments and field research on laser bioeffects, enabling military exploitation of laser technology while providing countermeasures for optical hazards/threats.			
FY 2012 Accomplishments: Initiated development of tools to assess collateral high energy laser hazards using probabilistic techniques. Develop new models and techniques for assessing vision effects from laser eye protection. Assessed human factors integration of laser eye protection with visor, helmet, and advanced cockpit designs. Researched advanced designs of personal protection in high energy, directed energy weapons hazard zones.			
FY 2013 Plans: Develop high power probabilistic range safety tools for predicting eye and skin hazard zones from high energy laser weapon systems. Develop models and methods for unique approaches using optical radiation for future weapon systems with scalable, disruptive, and ultra-precise effects. Develop parameters for optimizing laser vision effect models for advanced laser eye protection models and non-lethal weapons.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 627757: *Bioeffects*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Integrate operational tasks into laser vision effects models to identify impacts to human operators. Explore daytime dazzling effects via multiple wavelength stimulation in human subjects. Enhance dose-response models to support risk-based hazard analysis for low power probabilistic laser safety tools. Expand models and methods for application to unique approaches for using optical radiation for future weapon systems with scalable, disruptive, and ultra-precise effects.			
Title: Radio Frequency Bioeffects ***Description:*** Conduct laboratory experiments and field research to enable safe exploitation of directed energy technologies for communication, target identification, and weapons development. ***FY 2012 Accomplishments:*** Conducted EM radiation bioeffects research in support of national and international safety standards. Conducted biological studies of advanced directed energy weapon concepts. Conducted physiological and behavioral research to support scalable directed energy weapon capabilities. Developed scalable RFR effects models based on theoretical and experimental physics. Assessed bioeffects of combined directed energy sources. ***FY 2013 Plans:*** Integrate basic mechanisms of interactions between biology and RFR for validation of bioeffects models from ultra-short, high-peak power, RF systems. Investigate terahertz (THz) radiation effects on cells and tissues and improve bioeffects models for exposure. Initiate proposals for refined exposure standards for THz radiation. Assess combined biological effects from multiple, combined directed energy sources. ***FY 2014 Plans:*** Conduct empirical laboratory tests on the human behavioral response to combined effects of directed energy sources. Initiate validation of high-peak power exposure models. Incorporate THz exposure test results into THz exposure standards and whole-body exposure models.	8.388	8.111	8.302
Title: Molecular Bioeffects ***Description:*** Conduct studies to assess human responses to non-lethal weapons and effects/risks of these weapons. Conduct bio/nanotechnology research to advance warfighter performance. Leverage toxicological/biological data to improve human performance and decision-making abilities. ***FY 2012 Accomplishments:*** Developed a quantitative framework for relating directed energy and scalable novel-effects technologies (including non-lethal and escalation of force weapons) to operationally-relevant outcomes via research on physiological and psychological human effects. Established a database containing behavioral effectiveness and risk of injury information under operational conditions to facilitate coordination among operators, researchers, and weapon acquisition professionals. Developed methodology to	5.316	5.059	8.119

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 627757: *Bioeffects*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
quantify behavioral effectiveness (e.g., sensory, cognitive, motor) across the range of directed energy and scalable novel-effects technologies. Developed methodology to quantify the risk of injury (e.g., reversible, irreversible) across the range of non-lethal and escalation of force weapons. Pursued advanced analysis of new and emerging nanomaterials and biofuels of Air Force interest. Validated molecular markers in specific cognitive and physiological pathways that impact human performance. ***FY 2013 Plans:*** Expand the quantitative framework for relating directed energy and scalable novel-effects technologies to operationally relevant mission outcomes. Expand the knowledge base of behavioral effectiveness and risk of injury under operational conditions to facilitate non-lethal weapons wargaming and acquisition. Advance toxicity and nanotoxicity research; investigate/establish toxicity impacts to the body of advanced fuels, materials, and chemicals used to support existing and future weapon systems. Define and pursue modulation of major cell pathways affecting cognition using in vitro and in vivo models and modeling. ***FY 2014 Plans:*** Evaluate the quantitative framework for relating novel-effects technologies to operationally relevant mission outcomes. Conduct research to define toxicity issues in current and future aircraft environments. Begin development of models incorporating toxicity data and mechanisms of action to inform sensor development and development of hazard protection. Conduct research to elucidate novel mechanisms of fundamental interaction of nanomaterials in a biological system. Begin development of a new prototype of non-traditional effects of nanomaterials under the influence of incidental EM fields.			
Accomplishments/Planned Programs Subtotals	21.758	21.298	22.838

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*					R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	207.768	232.547	197.546	-	197.546	173.232	179.038	181.468	183.558	Continuing	Continuing
623012: *Advanced Propulsion Technology*	-	20.009	23.637	22.304	-	22.304	21.383	23.359	26.020	26.522	Continuing	Continuing
623048: *Combustion and Mechanical Systems*	-	19.717	15.874	13.235	-	13.235	12.491	12.527	12.645	12.886	Continuing	Continuing
623066: *Turbine Engine Technology*	-	70.515	102.188	77.444	-	77.444	52.595	55.965	52.887	52.433	Continuing	Continuing
623145: *Aerospace Power Technology*	-	32.066	30.061	26.587	-	26.587	28.717	29.453	28.127	28.679	Continuing	Continuing
624847: *Rocket Propulsion Technology*	-	59.331	55.293	52.651	-	52.651	52.904	52.570	56.535	57.680	Continuing	Continuing
625330: *Aerospace Fuel Technology*	-	6.130	5.494	5.325	-	5.325	5.142	5.164	5.254	5.358	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program develops propulsion and power technologies to achieve enabling and revolutionary aerospace technology capabilities. The program has six projects, each focusing on a technology area critical to the Air Force. The Advanced Propulsion Technology 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 Mechanical Systems project evaluates lubricants and combustion concepts and technologies for new and existing engines. The Turbine Engine Technology project develops enabling capabilities to enhance performance and affordability of existing weapon systems and develops component technologies for ultra high pressure ratio, substantially improved durability, and adaptive cycle engine architecture to provide optimized performance, fuel efficiency, and life for widely varying mission needs. The Aerospace Power Technology project develops electrical power and thermal management technologies for military applications that are part of energy optimized aircraft development. The Rocket Propulsion Technology project develops advances in rocket propulsion technologies for space access, space maneuver, missiles, the sustainment of strategic systems, and tactical rockets. The Aerospace Fuel Technology project evaluates hydrocarbon-based fuels for legacy and advanced turbine engines, scramjets, pulse detonation, and combined-cycle engines. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. 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 2014 Air Force					DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*			R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*		
B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	207.406	232.547	200.918	-	200.918
Current President's Budget	207.768	232.547	197.546	-	197.546
Total Adjustments	0.362	0.000	-3.372	-	-3.372
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	4.000	0.000			
• SBIR/STTR Transfer	-3.638	0.000			
• Other Adjustments	0.000	0.000	-3.372	-	-3.372

Change Summary Explanation

Decrease in FY14 is due to higher DoD priorities.

Received reprogramming from PE 0601103F University Research Initiative for Adaptive Versatile Engine Technology (ADVENT) effort.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623012: *Advanced Propulsion Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
623012: *Advanced Propulsion Technology*	-	20.009	23.637	22.304	-	22.304	21.383	23.359	26.020	26.522	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops combined/advanced cycle air breathing high-speed (up to Mach 4) and hypersonic (Mach 5 to 7) propulsion technologies to provide revolutionary propulsion options for the Air Force. These new engine technologies will enable future high-speed/hypersonic weapons and aircraft concepts. The primary focus is on hydrocarbon-fueled engines capable of operating over a broad range of flight Mach numbers. Efforts include modeling, simulations, and proof of concept demonstrations of critical components; advanced component development; and ground-based demonstrations.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Demonstrate Low Mach Scramjet Technologies	1.650	1.650	0.000
Description: Develop advanced fuel-cooled scramjet engine technologies to support flight demonstration and enable the broad application of hypersonics to meet future warfighter needs. ***FY 2012 Accomplishments:*** Developed and demonstrated advanced engine control systems and flight weight scramjet engine components. Developed and demonstrated closed loop engine control system with advanced instrumentation to increase scramjet engine operability at low scramjet Mach numbers. Conducted flight test using sounding rocket launch and successfully demonstrated transition from ramjet to scramjet. ***FY 2013 Plans:*** Complete development and demonstration of advanced engine control systems and flight weight scramjet engine components. Build upon prior ground and flight test data and experience to refine and demonstrate closed loop engine control system with advanced instrumentation to increase scramjet engine operability at low scramjet Mach numbers. Conduct direct connect testing of flight weight scramjet components for cold start systems. ***FY 2014 Plans:*** Advance scramjet engine controls and cold start demonstration development transferred to PE 0603216F Aerospace Propulsion, project 635098 Advanced Aerospace Propulsion.			
Title: Integrated Propulsion Technologies	0.165	0.120	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623012: *Advanced Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: Conduct assessments, technology design trades, and simulations to integrate combined cycle engines (CCEs) and air breathing hypersonic propulsion technologies into future systems. ***FY 2012 Accomplishments:*** Conducted trade studies to determine military payoff and establish component technology goals. ***FY 2013 Plans:*** Improve definition of component and engine performance objectives to enable development of affordable hypersonic flight demonstrators jointly with NASA and DARPA. Conduct development roadmapping. ***FY 2014 Plans:*** Effort transitioned to PE 0602203F, Thrust 3, Hypersonic Scramjet Technologies, where component technologies will be integrated into scramjet engine subsystems for hypersonic systems.			
Title: Hypersonic Scramjet Technologies ***Description:*** Develop robust hydrocarbon fueled scramjet engine components and technologies to improve performance, operability, durability, and scalability for future platforms. ***FY 2012 Accomplishments:*** Developed advanced engine components to improve scramjet operating margin and to refine scramjet scaling laws for reusable applications. Developed techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Developed low internal drag flame stabilization devices and flight test engine components. Completed preliminary designs of heavy weight scramjet combustor in medium scale (ten times) scramjet engines. ***FY 2013 Plans:*** Continue to develop advanced engine components to improve scramjet operating margin and to refine scramjet scaling laws for reusable applications. Continue to develop techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Continue to develop low internal drag flame stabilization devices and flight test engine components. Complete critical designs and initiate fabrication of scramjet combustors in medium scale (ten times) scramjet engines. Prepare for direct connect testing of medium scale (ten times) scramjet engines operating at Mach 3.5 to Mach 7 conditions. ***FY 2014 Plans:*** Continue to develop advanced engine components to improve scramjet operating margin and to refine scramjet scaling laws for reusable applications. Continue to develop techniques to decrease scramjet takeover from Mach 4.5 to Mach 3.5 to provide	18.194	21.867	22.304

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623012: *Advanced Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
robust options for CCEs. Continue to develop low drag flame stabilization devices and flight test components. Initiate direct testing of medium scale (ten times) scramjet engines operating at Mach 3.5 to Mach 7 conditions.			
Accomplishments/Planned Programs Subtotals	20.009	23.637	22.304

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623048: *Combustion and Mechanical Systems*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
623048: *Combustion and Mechanical Systems*	-	19.717	15.874	13.235	-	13.235	12.491	12.527	12.645	12.886	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project evaluates lubricants, mechanical systems, and combustion concepts for advanced turbine engines, pulse detonation engines, and combined cycle engines. This project also develops technologies to increase turbine engine operational reliability, durability, mission flexibility, maintainability, and performance while reducing weight, fuel consumption, and cost of ownership. Applications include missiles, aircraft, and sustained high-speed vehicles. Analytical and experimental areas of emphasis include lubricants, bearings, mechanical systems diagnostics, mechanical systems prognostics, rotor dynamics, oil-less engine technology, optical diagnostics, fundamental combustion, detonations, combustors, and afterburners. 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Combustion Technologies	8.367	6.202	5.133
Description: Develop, test, and evaluate revolutionary combustion and propulsion concepts for gas turbine, pulse detonation, and combined cycle engines for missiles, manned and unmanned systems.			
FY 2012 Accomplishments: Evaluated alternative fuels in combustion systems at relevant engine conditions. Tested full-scale compact combustor concept relevant to highly efficient, embedded turbine engine goals. Demonstrated small-scale propulsion system operation using reduced-octane fuels. Employed new physical models in simulation tools. Investigate pressure gain combustion concepts for application to propulsion systems. Continued studies of pulse detonation engine-turbine interactions. Investigated feasibility of rotary detonation engines (RDE) and continuous detonation engines.			
FY 2013 Plans: Develop new models for combustion processes at high pressure conditions. Test combustion system designs that produce low pollutant emissions. Test RDE concepts coupled with conventional turbomachinery. Evaluate alternative fuels and their impact on engine performance and durability. Test novel compact combustion systems at relevant operating conditions.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623048: *Combustion and Mechanical Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Implement new technologies to operate small-scale propulsion systems with reduced octane fuels. Continue to develop new RDE concepts.			
Title: Diagnostic Technologies ***Description:*** Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for application to revolutionary propulsion technologies. ***FY 2012 Accomplishments:*** Applied line-of-sight measurement techniques for temperature and species to combustion systems in a relevant engine environment. Demonstrated simultaneous high-speed planar laser-induced fluorescence and particle-image velocimetry for measurements of species and velocity fields in practical combustion devices. Demonstrated tomographic reconstruction of reacting flowfields in relevant combustion systems. ***FY 2013 Plans:*** Apply advanced laser diagnostics and novel optics configurations to high pressure test cell environment. Demonstrate particle image velocimetry in high pressure combustion test apparatus. Investigate high-speed measurement techniques for combustion temperature and species. ***FY 2014 Plans:*** Develop high-speed laser systems to measure combustion species, temperature, and velocity. Apply new diagnostics to combustion systems at relevant engine conditions. Refine fiber optic methods for high-power laser diagnostics use.	1.311	1.128	0.974
Title: Lubricant Technologies ***Description:*** Develop, test, and qualify advanced turbine engine lubricants. Generate and maintain military specifications for aviation engine lubricants. ***FY 2012 Accomplishments:*** Demonstrated surface modifiers on full-scale lubrication system components to prevent formation of solid deposits that can cause clogging. Developed engine mechanical system health management control algorithms for active rotor thrust balancing. Developed suite of technologies for intelligent lube system prognostics and health monitoring, such as integrated debris capture devices, real-time oil debris monitoring, and vibration sensing. Developed lubrication system thermal management technologies for reduced heat generation and improved heat dissipation for efficient turbine engines. ***FY 2013 Plans:***	4.966	4.181	3.490

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623048: *Combustion and Mechanical Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Demonstrate lube system health management control algorithms with full-scale technology readiness level 5 test rig hardware. Test enhanced ester oils in demonstrator turbine engines. Continue investigating advanced lube system thermal management technologies for fuel efficient turbine engines. Develop new oil traction models and validate experimentally. ***FY 2014 Plans:*** Finalize transition plans of enhanced ester oil to current and future engines. Qualify additional enhanced ester oil candidates for field use. Demonstrate advanced mechanical system health monitoring algorithms on full-scale demonstrator engine. Continue investigating advanced lube system thermal management technologies for fuel efficient engines. Incorporate new traction models into bearing heat generation models.			
Title: Bearing Technologies ***Description:*** Develop and test advanced bearing material technology and bearing concepts for small, intermediate, and large-sized turbine engine applications. ***FY 2012 Accomplishments:*** Conducted shakedown tests of active thrust balance rig. Developed and demonstrated robust thrust load sensing devices for highly loaded engine thrust bearings. Developed bearing spall debris monitoring model and limits and incorporated into thrust load control algorithm. Demonstrated oil debris monitoring technology fused with vibration sensing on seeded fault bearing rig tests. Developed new bearing heat generation models for engines and validated with full-scale bearing experimental performance data. ***FY 2013 Plans:*** Conduct parametric active thrust control experiments to validate load control algorithms. Conduct seeded fault bearing tests to validate reliable active and autonomous thrust load control. Integrate active thrust control, vibration, and oil debris sensing for complete TRL 5 mechanical system health management system. Coordinate plans for demonstrating active thrust control system in future TRL 6 engine demonstration. ***FY 2014 Plans:*** Conduct full-scale bearing tests in support of adaptive turbine engines. Conduct foil bearing rig tests in support of expendable supersonic turbine engine follow-on development. Develop improved bearing material life model. Mature autonomous active thrust bearing system. Finalize transition plans of hybrid ceramic/metallic bearings into upgrades of current aircraft.	5.073	4.363	3.638
Accomplishments/Planned Programs Subtotals	19.717	15.874	13.235

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623048: *Combustion and Mechanical Systems*

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623066: *Turbine Engine Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
623066: *Turbine Engine Technology*	-	70.515	102.188	77.444	-	77.444	52.595	55.965	52.887	52.433	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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, adaptive cycle technologies, and structural design. This project develops component technology for an adaptive cycle engine architecture that provides optimized performance/fuel efficiency for widely varying mission needs. This project supports joint Department of Defense, agency, and industry efforts to focus turbine propulsion technology on national needs. The program plan is relevant across capability areas for global responsive strike, tactical and global mobility, responsive space lift, and persistent intelligence, surveillance, and reconnaissance (ISR).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Turbofan/Turbojet Engine Core Technologies	41.133	40.578	35.125
Description: Develop core turbofan/turbojet engine components (i.e., compressors, combustors, and turbines) for fighters, bombers, sustained supersonic/hypersonic cruise vehicles, and transports.			
FY 2012 Accomplishments: Developed modeling and simulation rules and tools for advanced components including advanced interactive cost analysis tools for adaptive core components and unsteady aerodynamics/aeromechanics models. Conducted bench and rig tests to validate unsteady aerodynamics/aeromechanics models. Continued rig testing adaptive cycle features, an efficient compressor, an efficient turbine, and an efficient exhaust system. Developed and applied advanced modeling and simulation rules and tools to initiate definition and design of efficient, very high pressure ratio core component technologies.			
FY 2013 Plans: Continue to develop modeling and simulation tools for advanced components including coupled aerothermal models and turbine durability design. Continue to conduct bench and rig test using surface mapping thin film temperature gauges. Develop high resolution non-contact stress measurement systems for high frequency response measurement. Demonstrate engine efficiency			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623066: *Turbine Engine Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
improvements from active clearance and flow control. Conduct rig testing of high-power low-emission combustion. Develop improved compressor aerodynamic design tools to extend engine operability and efficiency. ***FY 2014 Plans:*** Continue developing modeling and simulation tools for advanced components including coupled aerothermal models; highly loaded, low emissions combustion systems; and turbine durability designs. Perform structural assessment research of combustor and turbine components operating in a realistic engine environment. Continue to develop improved compressor aerodynamic design tools to extend engine operability and efficiency. Initiate conceptual design of efficient, very high pressure ratio core component technologies. Decrease in FY 2014 due completion ADVENT.			
Title: Turbofan/Turbojet Engine Fan, Low Pressure Turbine, and Integration Technologies ***Description:*** Develop turbofan/turbojet engine components (i.e., fans, nozzles, etc.) used in engines for fighters, bombers, sustained supersonic strike and hypersonic cruise vehicles, and transports. ***FY 2012 Accomplishments:*** Developed modeling and simulation rules and tools for advanced components including: advanced interactive cost analysis tools for adaptive engine components; unsteady aerodynamics and aeromechanics models; augmentor combustion processes; and probability-based cooled turbine airfoil high cycle fatigue prediction methods. Conducted bench and rig tests to validate unsteady aerodynamics/aeromechanics models and probabilistic cooled turbine airfoil high cycle fatigue prediction methods. Developed and validated test protocols and improved augmentor rig test capabilities. Continued rig testing of advanced fan design, advanced low pressure turbine design, and lightweight, simple, low-observable compatible inlet and exhaust systems. ***FY 2013 Plans:*** Develop modeling and simulation tools including methods to predict behavior of serpentine inlets and nozzles. Demonstrate methods to detect/predict incipient bearing damage to ensure engine operation. ***FY 2014 Plans:*** Continue to develop modeling and simulation tools including methods to predict behavior of serpentine inlets and nozzles. Develop modeling and simulation tools to predict fan/inlet interaction for both podded and embedded propulsion systems. Develop a probabilistic ignition prediction tool for advanced augmentor design. Develop models to validate function and durability of high temperature electronics for engine control.	14.323	8.672	8.177
Title: Missile and Remotely Piloted Aircraft Engine Technologies ***Description:*** Develop limited life engine components for missile and remotely piloted aircraft (RPA) applications, including long-range supersonic and hypersonic vehicles.	5.400	3.993	3.900

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623066: *Turbine Engine Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Developed and applied advanced modeling and simulation rules and tools for ceramic material small turbine blades, variable area turbines, and integration/performance of lubeless bearings. Developed and evaluated components to increase pressure ratio by 50% in this size class with minimum efficiency loss. ***FY 2013 Plans:*** Develop and apply advanced modeling and simulation tools for variable cycle component design, advanced cooling concepts, compact augmentors, and composite structures. Demonstrate advanced designs in rig testing. ***FY 2014 Plans:*** Continue to develop and apply advanced modeling and simulation tools for variable cycle component design, advanced cooling concepts, compact augmentors, and composite structures. Continue to demonstrate advanced designs in rig testing. Develop and validate a test protocol for small engine augmentor designs.			
Title: Turboshaft/Turboprop and Small Turbofan Engine Technologies ***Description:*** Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports. ***FY 2012 Accomplishments:*** Developed and applied advanced modeling and simulation rules and tools for emissions and noise to decrease detection. Developed and evaluated components to increase thrust-to-weight ratio and to decrease specific fuel consumption, production cost, and development cost. ***FY 2013 Plans:*** Develop and apply advanced modeling and simulation tools for advanced cooling concepts, high efficiency gearboxes, and high performance airfoils. Develop advanced vibration and temperature sensors for use in demonstration of engine durability requirements. ***FY 2014 Plans:*** Continue to develop and apply advanced modeling and simulation tools for advanced cooling concepts, high efficiency gearboxes, and high performance airfoils. Continue to develop advanced vibration and temperature sensors for use in demonstration of engine durability requirements.	1.659	1.545	1.563
Title: Adaptive Turbine Engine Technologies ***Description:*** Develop high performance, durable components which enable adaptive turbine engine technologies.	8.000	47.400	28.679

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623066: *Turbine Engine Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Initiated multiple analyses and trade studies required to finalize adaptive engine conceptual designs. The adaptive engine conceptual design goals include 25% reduction in specific fuel consumption and 10% increase in thrust within the weight and unit cost constraints of state-of-the-art fifth generation fighter class engines. ***FY 2013 Plans:*** Complete adapative engine conceptual designs meeting goals to reduce 25% reduction in specific fuel consumption and 10% increase in thrust over fifth generation fighter class engines with comparable weight and unit cost. Initiate preliminary designs addressing extensive performance, operability, maintainability, and prognostic health management requirements. Design and conduct ground rig tests to validate preliminary design technologies and reduce risk for several parts of adaptive engines such as adaptive fans, high pressure compressors, combustors, high and low pressure turbines, mechanical system components, controls and accessories, thermal management subsystems, and three-stream compatible afterburner/exhaust systems. Conduct ground rig testing of at least two unique adaptive fan concepts. Complete the design, procurement, and assembly of hardware for ground rig tests and initiate ground rig tests. ***FY 2014 Plans:*** Complete detailed design of at least two unique adaptive fan concepts and initiate fabrication of components for ground engine testing. Continue to conduct ground rig tests to validate preliminary design technologies and reduce risk for several parts adaptive engines. Transition effort from development to demonstration of parts of adaptive engines.			
Accomplishments/Planned Programs Subtotals	70.515	102.188	77.444

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623145: *Aerospace Power Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
623145: *Aerospace Power Technology*	-	32.066	30.061	26.587	-	26.587	28.717	29.453	28.127	28.679	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 future military megawatt level power and thermal management needs. 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: High Power System Technologies	26.258	29.805	26.587
Description: Develop electrical power and thermal management component and subsystem technologies with low volume displacement for delivery of high power for manned and unmanned systems. ***FY 2012 Accomplishments:*** Performed tip-to-tail modeling and simulation to identify solutions for platform level power and thermal management needs of next generation military air platforms. ***FY 2013 Plans:*** Complete critical design review of Integrated Vehicle Energy Technology (INVENT) effort to develop adaptive power and thermal management subsystems for next generation military air platforms. Initiate platform tip-to-tail modeling and simulation energy optimization for potential INVENT integration into current and future fifth generation fighter class aircraft. ***FY 2014 Plans:*** Initiate testing of adaptive power and thermal management subsystems hardware for next generation air platforms in conjunction with continued platform level tip-to-tail modeling and simulation energy optimization.			
Title: Special Purpose Application Technologies	5.808	0.256	0.000
Description: Develop technologies for special purpose applications, including hybrid electrical power, thermal management systems, and energy conversion/storage components and subsystems.			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623145: *Aerospace Power Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Developed fully ruggedized hybrid power subsystems and energy harvesting components. Performed flight tests of these subsystems to demonstrate achievement of power and energy density goals for special purpose applications. Explored technology set for development of power systems for micro air vehicles. ***FY 2013 Plans:*** Complete power generation and management advanced technology demonstration to transition to Air Force customer, Air Force Special Operations Command (AFSOC), to provide enhanced capability and endurance for battlefield airmen. This effort completion and transition incorporates and leverages components developed in prior year activities. ***FY 2014 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	32.066	30.061	26.587

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 624847: *Rocket Propulsion Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
624847: *Rocket Propulsion Technology*	-	59.331	55.293	52.651	-	52.651	52.904	52.570	56.535	57.680	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops rocket propulsion technologies for space access, space maneuver, 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, and innovative 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 sustainment of the rocket propulsion industry, providing rocket propulsion technology for the entire DoD. Technologies developed under this program enable capabilities of interest to both DoD and 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%, enabling motor replacement for cause.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Fuel Technologies	4.943	7.035	7.156
Description: Develop, characterize, and test advanced hydrocarbons, energetics, solid propellants, and monopropellants to increase space launch payload capability and refine new synthesis methods.			
FY 2012 Accomplishments: Analyzed and tested potential hydrocarbon fuel additives to improve performance of kerosene. Evaluated scaled-up propellants in advanced combustion devices to determine materials compatibility and performance to include supporting large-scale motor tests. Explored and developed advanced ionic liquids including synthesis and characterization. Evaluated suitability for ionic liquid propellants for missile defense interceptor and spacecraft propulsion demonstrations.			
FY 2013 Plans: Analyze and test new candidates for potential hydrocarbon fuel additives to improve performance of kerosene. Continue synthesis and downselect process and scale-up of promising high energy-density materials candidates. Continue to develop methods and additives to reduce fuel coking in rocket engine environments. Evaluate candidate propellants in advanced			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 624847: *Rocket Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
combustion devices. Develop and characterize next generation ionic liquids for use in spacecraft and missile defense applications. Develop scale-up capability for advanced solid propellant ingredients. ***FY 2014 Plans:*** Evaluate methods for removing components from fuels that adversely affect fuel coking in rocket engine environments. Evaluate scaled-up propellants in advanced combustion devices to determine materials compatibility and performance to include supporting large-scale motor tests. Continue development and characterization of next generation ionic liquid propellants for use in spacecraft and missile defense applications. Complete scale-up capability for advanced solid propellant ingredients. Evaluate and modify polymeric systems for use in rocket applications.			
Title: Liquid Engine Combustion Technologies ***Description:*** Develop advanced liquid engine combustion technology for improved performance, while preserving chamber lifetime and reliability needs for engine uses in heavy lift space vehicles. ***FY 2012 Accomplishments:*** Evaluated injector performance to ensure chamber/injector compatibility and prevent damage to engines using sub-scale ground engine demo. Validated study results in more realistic rocket-chamber conditions and transitioned predictive tools to industry. Started modification of test cell to allow hot-firing of combustion stability characterizing rig. Characterized differences between different kerosone rocket fuel batches which impact their coking behavior in a rocket engine. Evaluated novel nozzle cooling channels for use with hydrocarbon fuels in the high heat flux test rig. ***FY 2013 Plans:*** Begin efforts looking at multi-injector designs and control effectors. Feed advanced combustion device technology into a hydrocarbon boost demo and to various contractor designs and continue additional analysis on changing designs and concepts. Develop improved understanding of fundamental combustion and fluid flow/heat transfer processes leading to new methodologies for thermal management, scaling, and combustion instabilities in hydrocarbon fueled liquid rocket engines, reducing the need for conducting large numbers of costly full-scale component and engine tests. Evaluate novel nozzle cooling channels for use with hydrocarbon fuels in the high heat flux test rig. Conduct validation and verification of advanced modeling and simulation capabilities. Develop understanding of kerosene production to determine what components affect fuel coking and should be removed from the fuel during the production process. Complete modification of test cell and conduct first hot-fire tests of combustion stability rig. ***FY 2014 Plans:*** Begin evaluation of injector concepts in hot fire conditions. Continue efforts looking at multi-injector designs and control effectors. Complete transition of candidate injector technologies to contractor for use in Hydrocarbon Boost (HCB), a rocket engine ground demonstration. Continue hot fire tests in combustion stability rig and feed data to HCB to influence supporting design efforts.	5.387	7.174	8.709

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 624847: *Rocket Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue characterization of novel cooling channels and transfer info to HCB to influence rocket engine thrust chamber design. Continue developing understanding of kerosene production, what components affect fuel coking and should be removed from the fuel during the production process. Continue to evaluate and develop advanced material solutions for high temperature components in rocket engines.			
Title: Advanced Material Applications ***Description:*** Develop advanced material applications for lightweight components and material property enhancements for current and future rocket propulsion systems. ***FY 2012 Accomplishments:*** Developed new material formulations that better address the challenges inside solid rockets. Continued to characterize and finalize processing parameters of new reinforced high temperature polymers and scale-up processing of carbon-carbon materials. Refined formulations of polymers for use in various liquid rocket engine components. Continued to characterize and understand the mechanisms behind a new class of hydrophobic and oleophobic materials exploring various transition opportunities. ***FY 2013 Plans:*** Support transition efforts of advanced polymers to operational missile systems. Down select to single method of material deposition, characterize and document for follow-on development and future potential acquisition programs. Finish nano-material activities and document. ***FY 2014 Plans:*** N/A.	5.722	1.000	0.000
Title: Advanced Liquid Engine Technologies ***Description:*** Develop advanced liquid engine technologies for improved performance, while increasing life and reliability needs for engine uses in expendable and reusable launch vehicles. ***FY 2012 Accomplishments:*** Completed development of engine health monitoring technologies supporting the hydrocarbon boost technology development effort. Completed development of advanced hydrocarbon engine technologies using fuels other than kerosene, including Methane. ***FY 2013 Plans:*** Develop enabling hydrocarbon boost technology for future spacelift concepts and continue risk reduction activities for the development of hydrocarbon boost technologies. Develop and demonstrate in-house, moderate scale liquid rocket component	16.300	10.872	10.623

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 624847: *Rocket Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
testing capability. Complete gas phase and super critical phase testing capability and begin experiments, which is also work supporting risk reduction in hydrocarbon boost. Develop high performance compact liquid rocket engine technologies. ***FY 2014 Plans:*** Continue to develop enabling hydrocarbon boost technology for future spacelift concepts and continue risk reduction activities for the development of hydrocarbon boost technologies (subscale turbopump assembly, thrust chamber assembly. Continue to develop and demonstrate in-house, moderate scale liquid rocket component testing capability-complete hot fire capability to support risk reduction in hydrocarbon boost technology. Continue to develop high performance compact liquid rocket engine technologies.			
Title: On-Orbit Propulsion Technologies ***Description:*** Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for station-keeping, repositioning, and orbit transfer for satellites and satellite constellations. ***FY 2012 Accomplishments:*** Characterized advanced plasma thrusters for microsatellite propulsion systems. Conducted scale-up of advanced monopropellants and evaluated advanced ignition schemes and chamber concepts. Assessed advanced chemical propulsion technology developments for satellite thrusters and development components. Developed advanced multi-mode chemical-electric propulsion concepts for satellites and continued component developments. Developed next generation high power electric spacecraft propulsion. Performed advanced modeling and simulation tool development to improve design and analysis tools for a wide range of spacecraft propulsion concepts/technologies. ***FY 2013 Plans:*** Conduct scale-up of advanced monopropellants and evaluate advanced ignition schemes and chamber concepts. Continue development of next generation high power electric spacecraft propulsion. Continue advanced modeling and simulation tool developments to improve design and analysis tools for a wide range of spacecraft propulsion concepts/technologies. Begin development of new bi-propellant thruster technologies to take advantage of new non-toxic liquid propellants. ***FY 2014 Plans:*** Conduct scale-up of advanced monopropellants and evaluate advanced ignition schemes and chamber concepts. Continue development of next generation high power electric spacecraft propulsion. Continue advanced modeling and simulation tool developments to improve design and analysis tools for a wide range of spacecraft propulsion concepts/technologies, incorporating multi-scale/multi-physics. Conduct experiments to understand the physics behind the wide range of spacecraft propulsion	6.651	8.330	9.409

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 624847: *Rocket Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
concepts/technologies and accurately model the physics. Begin transition of new thruster modeling framework to spacecraft industry for use in future designs. Explore and develop new generation of chemical spacecraft thruster technologies.			
Title: Space Access and Strike Applications ***Description:*** Develop missile propulsion and boost technologies for space access and strike applications. ***FY 2012 Accomplishments:*** Tested components as part of risk reduction efforts for future missile propulsion demonstration. Developed advanced tactical propulsion technologies. Continued development and evaluation of next generation of updated, physics-based modeling, simulation, and analysis tools for missile propulsion components and applications. ***FY 2013 Plans:*** Develop advanced tactical propulsion technologies. Continue development and evaluation of next generation of updated, physics-based modeling, simulation, and analysis tools for missile propulsion components and applications. Develop advanced component technologies for missile propulsion applications for strategic and strike systems helping to ensure their long-term sustainment. ***FY 2014 Plans:*** Continue to develop advanced tactical propulsion. Continue development and evaluation of next generation of updated, physics-based modeling, simulation, and analysis tools for missile propulsion components and applications. Continue to develop advanced component technologies for missile propulsion applications for strategic and strike systems helping to ensure their long-term sustainment. Complete propellant development efforts.	14.884	11.476	6.739
Title: Ballistic Missile Technologies ***Description:*** Develop missile propulsion technologies and aging and surveillance technologies for ballistic missiles. ***FY 2012 Accomplishments:*** Conducted sub-scale testing of existing and advanced sensors to be attached to solid rocket motors and tools that can integrate sensor data into existing aging and surveillance tool suite. Integrated advanced aging and surveillance technologies into demonstrations to validate and verify efforts to reduce uncertainties and accurately model motor behavior. Applied next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and non-destructive analysis tools. ***FY 2013 Plans:*** Conduct sub-scale testing of existing and advanced sensors to be attached to solid rocket motors and tools that can integrate sensor data into existing aging and surveillance tool suite. Integrate advanced aging and surveillance technologies into	5.444	9.406	10.015

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 624847: *Rocket Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
demonstrations to validate and verify efforts to reduce uncertainties and accurately model motor behavior. Continue to apply next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and non-destructive analysis tools. ***FY 2014 Plans:*** Conduct sub-scale testing of existing and advanced sensors to be attached to solid rocket motors and tools that can integrate sensor data into existing aging and surveillance tool suite. Continue integration of advanced aging and surveillance technologies into demonstrations to validate and verify efforts to reduce uncertainties and accurately model motor behavior. Apply next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and non-destructive analysis tools. Complete data management system used to track and correlate aging and surveillance data for individual missiles.			
Accomplishments/Planned Programs Subtotals	59.331	55.293	52.651

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 625330: *Aerospace Fuel Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
625330: *Aerospace Fuel Technology*	-	6.130	5.494	5.325	-	5.325	5.142	5.164	5.254	5.358	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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), unique/alternate 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Alternative Fuels	3.042	2.500	2.372
Description: Conduct evaluations and perform technical assessments of alternative hydrocarbon fuels derived from coal, natural gas, and biomass for use in legacy and advanced aerospace systems.			
FY 2012 Accomplishments: Developed link between fully-synthetic fuel composition and basic physical properties and rig test performance.			
FY 2013 Plans: Continue evaluation of industry-submitted alternative fuel samples. Tri-service coordinated efforts focus on hydrocarbon composition, jet-in-diesel performance, bulk modulus, and stability during long-term military storage/handling.			
FY 2014 Plans: Continue evaluation of cellulosic aviation biofuels, focusing on potential fuels capable of being used at a 100% pure state rather than blends.			
Title: Integrated Thermal and Energy Management	1.088	1.100	1.045
Description: Develop and demonstrate advanced components and conduct performance assessments of advanced aircraft integrated thermal and energy management systems for engines and aircraft.			
FY 2012 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 625330: *Aerospace Fuel Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Assessed advanced catalyst approaches to enhancing heat sink in hydrocarbon-based endothermic fuels. ***FY 2013 Plans:*** Evaluate alternative fuel compositions to increase life and heat sink in hydrocarbon-based endothermic fuels, using reduced-scale rigs to simulate engine-scale fuel system conditions. ***FY 2014 Plans:*** Develop advanced producible endothermic fuel composition with enhanced heat sink and life to support medium-scale scramjet engine demonstrations.			
Title: Fuel Logistics ***Description:*** Study and evaluate low-cost approaches to reduce fuel logistics footprint to reduce cost. Study fuel logistics vulnerabilities and develop detection and mitigation technologies. ***FY 2012 Accomplishments:*** Developed biological growth mitigation approaches for commercial jet fuels in support of Air Force effort to implement commercial off-the-shelf jet fuels. Evaluated approaches for portable hydrogen generation to support emergency field power generation. ***FY 2013 Plans:*** Assess impact of conversion to commercial jet fuel (without military jet fuel additives) on biological growth in base fuel systems. Evaluate cross-section of Jet A fuels using advanced instrumentation to develop chemical composition information to link to fuel properties and performance to support Jet A conversion. ***FY 2014 Plans:*** Develop composition-to-performance link and models for Jet A fuels for physical properties.	1.000	1.000	0.958
Title: Emissions ***Description:*** Develop and test advanced emissions diagnostic techniques for airbreathing propulsion systems. Conduct evaluations of the combustion and emissions characteristics of aviation fuels. ***FY 2012 Accomplishments:*** Implemented advanced particulate diagnostics in high-pressure combustor test rig. Assessed emissions from fully-synthetic fuels relative to JP-8 and JP-8/synthetic blends. ***FY 2013 Plans:*** Develop methodology to assess operability of fuels in high pressure combustor rig. ***FY 2014 Plans:***	1.000	0.894	0.950

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 625330: *Aerospace Fuel Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Evaluate combustor operability of narrow-boiling and high/low cetane alternative fuels as well as fully-synthetic fuels.			
Accomplishments/Planned Programs Subtotals	6.130	5.494	5.325

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*					R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	136.327	127.637	127.539	-	127.539	130.587	130.131	141.846	148.080	Continuing	Continuing
622002: *Electronic Component Technology*	-	35.757	31.683	36.220	-	36.220	39.807	40.141	40.684	41.602	Continuing	Continuing
622003: *EO Sensors & Countermeasures Tech*	-	30.491	23.744	23.078	-	23.078	23.717	20.141	21.844	22.283	Continuing	Continuing
626095: *Sensor Fusion Technology*	-	25.724	28.672	25.458	-	25.458	24.400	24.714	28.243	28.808	Continuing	Continuing
627622: *RF Sensors & Countermeasures Tech*	-	44.355	43.538	42.783	-	42.783	42.663	45.135	51.075	55.387	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program develops the technology base for Air Force aerospace sensors and electronic combat. Advances in aerospace sensors are required to increase combat effectiveness by providing anytime, anywhere surveillance, reconnaissance, precision targeting, and electronic warfare capabilities. To achieve this progress, this program pursues simultaneous advances in: 1) generating, controlling, receiving, and processing electronic and photonic signals for radio frequency (RF) sensor aerospace applications; 2) electro-optical (EO) aerospace sensor technologies for a variety of offensive and defensive uses; 3) RF antennas and associated electronics for airborne and space surveillance, together with active and passive EO sensors; 4) technologies to manage and fuse on-board sensor information for timely, comprehensive situational awareness; and 5) technology for reliable, all-weather surveillance, reconnaissance, and precision strike RF sensors and electronic combat systems. This program has been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. 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 2014 Air Force					DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*			R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*		
B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	134.632	127.637	128.591	-	128.591
Current President's Budget	136.327	127.637	127.539	-	127.539
Total Adjustments	1.695	0.000	-1.052	-	-1.052
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	3.351	0.000			
• SBIR/STTR Transfer	-1.656	0.000			
• Other Adjustments	0.000	0.000	-1.052	-	-1.052

Change Summary Explanation

Decrease in FY 2014 is due to higher DoD priorities.

Reprogrammed for specific projects in accordance with Section 219 of the Duncan Hunter National Defense Authorization Act for Fiscal Year (FY) 2009, as amended by Section 2801 of the National Defense Authorization Act for FY 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
622002: *Electronic Component Technology*	-	35.757	31.683	36.220	-	36.220	39.807	40.141	40.684	41.602	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project focuses on generating, controlling, receiving, and processing electronic signals for RF 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Multifunction Sensor Subsystems	10.396	12.238	11.681
Description: Develop, analyze, demonstrate, and perform engineering trade studies for technologies for compact, affordable, multi-function subsystems for aerospace sensors.			
FY 2012 Accomplishments: Completed first demonstrations of higher performance, with reduced size and weight, of advanced sensor front-ends. Developed initial trade space models for advanced sensing and electronic warfare front-ends. Developed compact and lightweight high-frequency antennas.			
FY 2013 Plans: Complete second round of demonstrations. Using engineering trade analysis, start development of optimized sensor system technology previously demonstrated.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Develop and demonstrate a capability to predict performance versus lifetime in military relevant environments for a large variety of emerging electronic devices. Initiate engineering trade analysis, start development of optimized sensor system technology. Develop initial trade space models for advanced sensing and electronic warfare front-ends.			
Title: Microelectronic/Optoelectronic Technologies ***Description:*** Develop and assess new microelectronic/optoelectronic material, device and fabrication technologies for next generation imaging, precision strike, and battlespace access across all Air Force domains. ***FY 2012 Accomplishments:*** Fabricated and characterized innovative electronic device concepts for wideband, reconfigurable and tunable applications. Demonstrated prototype hardware for agile/affordable advanced detector arrays with emphasis on combined spectro-polarimetric filtering. Conducted application development of high-brightness and agile waveform sources for integration into components and subsystems. Investigated and performed analysis for materials/device/circuit trades. ***FY 2013 Plans:*** Develop optimized device concepts for multi-use cyber, sensing, warfare and communication applications. Continue to develop and demonstrate a capability to predict performance versus lifetime in military relevant environments for a large variety of emerging electronic devices. Identify key failure mechanisms for electronic device technologies and their corresponding accelerants and chemistry. ***FY 2014 Plans:*** Continued the development of optimized device concepts for Multi-use cyber, sensing, warfare and communication applications. Identify and evaluate concepts for compact, high-performance electro-optic and electronic devices and components. Synthesize test articles, characterize behavior, and optimize fabrication methods for enhanced devices and components. Develop tools and methods for analysis and efficient design of game-changing components.	9.556	9.150	13.654
Title: Power Consumption ***Description:*** Develop, fabricate, and test electronic and optoelectronic devices and techniques to reduce power loss and power consumption for future imaging, electronic warfare, and ISR sensors. ***FY 2012 Accomplishments:*** Refined and transitioned solutions for multi-function electronic and optoelectronic components for imaging and electronic warfare applications. Investigated and analyzed mixed electronic and optoelectronic functions. ***FY 2013 Plans:***	6.629	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
N/A. Effort terminated due to higher DoD priorities. ***FY 2014 Plans:*** N/A			
Title: Mixed-Signal Component Technologies ***Description:*** Develop integrated design, modeling and simulation tools, and integration techniques for complex mixed-signal component development in advanced electronic component technologies. ***FY 2012 Accomplishments:*** Developed and demonstrated prototypes of complex mixed-technology (digital, RF, microwave, optical, and mechanical) components using both advanced and emerging electronic component technologies. ***FY 2013 Plans:*** Continue demonstration of microsystem prototypes. Refine trade analysis. ***FY 2014 Plans:*** N/A. Effort terminated due to higher DoD priorities.	4.526	4.576	0.000
Title: Antennas ***Description:*** Design and develop antennas for airborne and space-based surveillance. Develop novel and advanced antennas for lightweight, conformal arrays. ***FY 2012 Accomplishments:*** Integrated new detection algorithm with low-cost seeker hardware. Demonstrated integration and test of new conformal digital beamforming phased array antennas on airborne radar platforms. Developed new hardware to exploit emerging metamaterials for compact radiating sensor applications including conformal array antennas and electronics based upon complex media. Assessed the viability of obtaining novel material properties consistent with the demonstration of highly integrated subsystems based upon RF integrated circuit applications to enable small, highly directional antenna element device drivers. ***FY 2013 Plans:*** Develop novel antenna concepts for wideband applications. Integrate and demonstrate lightweight conformal phased array aperture. ***FY 2014 Plans:*** Initiate development of optimized antenna concepts for multi-use sensing, electronic warfare and communication applications. Fabricate and characterize innovative electronic device concepts for wideband, reconfigurable and tunable, and trusted	4.650	5.719	6.305

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
applications. Demonstrate prototype hardware for agile/affordable advanced detector arrays with emphasis on combined spectro-polarimetric filtering. Design and fabricate high-brightness and agile waveform sources for integration into components and subsystems.			
Title: Trusted Systems for ISR and Avionics Systems ***Description:*** Investigate and develop designs of trusted electronic and optoelectronic systems when integrating commercially available solutions (COTS) with emerging GOTs advanced technologies. Areas of development include: multi-function RF and EO subsystems, metamaterials, data compression, high-frequency power modules, EO/IR sources, EO/IR detectors, beam control and waveguides, and trusted and reliable electronics. ***FY 2012 Accomplishments:*** N/A ***FY 2013 Plans:*** N/A ***FY 2014 Plans:*** Initiate development of optimized device concepts for multi-use cyber, sensing, warfare and communication applications. Fabricate and characterize innovative electronic device concepts for wideband, reconfigurable and tunable, and trusted applications. Demonstrate prototype hardware for agile/affordable advanced detector arrays with emphasis on combined spectropolarimetric filtering. Design and fabricate high-brightness and agile waveform sources for integration into components and subsystems.	0.000	0.000	4.580
Accomplishments/Planned Programs Subtotals	35.757	31.683	36.220

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
622003: *EO Sensors & Countermeasures Tech*	-	30.491	23.744	23.078	-	23.078	23.717	20.141	21.844	22.283	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Non-cooperative Detection and Identification Technologies	5.936	10.377	11.102
Description: Develop innovative optical sensing technology for non-cooperative detection and identification of airborne and ground-based targets.			
FY 2012 Accomplishments: Conducted sensor concept demonstrations for long-range target identification using passive and active techniques, including multispectral/polarimetric imaging, vibrometry, 3-D, sparse aperture and synthetic aperture laser radar. Extended signature collection experiments and demonstrated techniques for long-range object reconstruction/ shape extraction based on multi-aspect multispectral and polarimetric images and coherent laser radar data. Initiated study of advanced sensing methods for overcoming atmospheric limitations to extended recognition range. Performed field experiments, quantify utility, and develop concepts for airborne experiments of synthetic aperture imaging in the presence of atmospheric turbulence. Developed model-based algorithms for longwave hyperspectral change detection.			
FY 2013 Plans: Continue sensor concept demonstrations for long-range target identification using innovative passive and active techniques. Perform longwave hyperspectral change detection experiments to assess model-based algorithms. Continue laboratory and begin field demonstrations of agile multifunction waveforms for long-range, combined temporal synthetic aperture and remote vibrometry			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
waveforms. Begin buildup of linear frequency modulation testbed to support long range performance quantification. Continue development of signal processing and automated signature recognition algorithms for remote vibrometry. ***FY 2014 Plans:*** Develop innovative sensor concepts to increase long range image quality for passive electro-optical and infrared reconnaissance sensors for high altitude platforms. Assess fundamental geometrical environmental and atmospheric limitations to system performance. Develop approaches for image restoration. Continue longwave infrared hyperspectral phenomenology and change detection research.			
Title: Inovative Optical Sensing Technologies ***Description:*** Develop innovative optical sensing technology to support military operations in dynamic and urban environments. ***FY 2012 Accomplishments:*** Performed hyperspectral phenomenology experiments and initiated trade studies for spectral-aided tracking and relocation of targets. Conducted laboratory experiments and began field demonstrations of holographic aperture imaging for high resolution 2-D and 3-D imaging. Conducted demonstrations of multi-aperture transceivers with wavelength and transmitter location diversity. Developed signal processing and automated signature recognition algorithms for remote vibrometry. Developed 3-D imaging technologies for urban applications including scaled sensor designs, modeling and simulation and flight test of prototype sensors. Initiated development of wide area and targeting specific processing algorithms. ***FY 2013 Plans:*** Develop processing methods and sensor requirements for spectral-aided tracking and relocation of targets. Conduct tower demonstrations of multi-aperture transceivers with wavelength and transmitter location diversity. Continue development of signal processing and automated signature recognition algorithms for remote vibrometry. ***FY 2014 Plans:*** This effort moves to Thrust 3 - EO/IR Sensors and Threat Countermeasures in this project to better align efforts.	3.057	0.672	0.000
Title: EO/IR Sensors and Threat Countermeasure Technologies ***Description:*** Develop optical and infrared sensors for airborne and space situational awareness and threat warning. Develop countermeasure technologies for use against infrared and electro-optical guided missile threats. ***FY 2012 Accomplishments:*** Conducted the assessment of advanced infrared missiles and infrared acquisition sensors. Developed simulation and hardware-in-the-loop test capability to characterize hardware and evaluate/test countermeasure concepts. Conducted development and integration of advanced laser threat detection sensors to demonstrate situational awareness and countermeasure hand-	7.819	2.758	6.215

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
off capabilities. Developed simulation and hardware-in-the-loop test capability to characterize hardware and evaluate/test threat warning and countermeasure concepts. Developed performance requirements for advanced electro-optical and infrared countermeasure concepts across mission concepts of employment. ***FY 2013 Plans:*** Continue the assessment of advanced infrared missiles and infrared acquisition sensors. Develop system requirements for Proactive Infrared Countermeasures (PIRCM) to defeat advance infrared (IR) guided missile and IR acquisition and tracking sensor operating in the near to mid-IR bands. Continue development and integration of advanced missile warning sensors to demonstrate situational awareness and countermeasure hand-off capabilities. Continue developing simulation and hardware-in-the-loop test capability to characterize hardware and evaluate/test threat warning and countermeasure concepts. Perform technology development of laser IRCM hardware suitable in size, weight and performance for fighter and mobility aircraft. ***FY 2014 Plans:*** Refine modeling and simulations for multiple ladar modes. Conduct laboratory testing of initial foundry runs of focal planes optimized for three dimensional and holographic imaging. Continue development of optical materials and devices for improved reliability and performance of mid-infrared lasers operating in harsh environments. Begin test of prototype Silicon Gallium (SiGa) detectors. Start design and fabrication of SiGa focal plane array.			
Title: Optical Technologies	5.506	5.271	5.761
Description: Develop optical spectrum transmitter, detector and agile aperture technologies capable of sensing multiple target characteristics for robust non-cooperative target identification and future infrared countermeasure systems. ***FY 2012 Accomplishments:*** Developed beamsteering technology for sparse aperture and compact 3-D laser radar systems. Performed characterization of competing beamsteering component technology concepts. Initiated proof of concept experiments for an agile aperture assembly. Developed design concepts for wideband optical detector arrays suitable for coherent laser radar systems. Defined and implemented optimized waveforms for laser-based sensing. Conducted active and passive sensor phenomenology experiments and model development. Demonstrated initial mid-infrared lasing and frequency conversion in waveguide and fiber media to reduce use of coupling optics for improved reliability and reduced cost of laser sources operating in harsh environments. ***FY 2013 Plans:*** Demonstrate high speed and random access optical phased array scanning with photon counting arrays. Demonstrate increased mid-infrared power and efficiency in waveguide and fiber media to reduce use of coupling optics for improved reliability and reduced cost of laser sources operating in harsh environments. ***FY 2014 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Refine and demonstrate candidate component technologies for image stabilization and restoration. Determine the utility of non-traditional sensor architectures in improving image quality and the operational range of passive imagers. Initiate prototyping of a flexible, next generation long wave infrared hyperspectral imaging spectrometer.			
Title: Next Generation EO Sensor Technologies ***Description:*** Develop and fabricate new semiconductor components, materials and techniques with capability to identify military and urban threats, to provide threat warning, and precisely engage targets in cluttered environments. Develop emerging optoelectronic materials, devices and circuits for next generation EO sensors exploiting advanced operational modes such as plasmonics, metamaterials, non-linear optics and quantum optics. ***FY 2012 Accomplishments:*** Capitalized on performance enhancements by integrating new materials with advanced plasmonic device technology at the macro, micro and nano scales. Applications included: non-cooperative target identification, automatic target recognition (ATR), ultraviolet to infrared threat warning, countermeasures, communications, computing and urban surveillance. ***FY 2013 Plans:*** Develop new semiconductor materials and devices for military-specific applications such as biological agent detection and covert communications, as well as phase-only correlation techniques for ATR. ***FY 2014 Plans:*** This effort moves to Thrust 3 - EO/IR Sensors and Threat Countermeasure Technologies in this Project to better align efforts.	8.173	4.666	0.000
Accomplishments/Planned Programs Subtotals	30.491	23.744	23.078

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
626095: *Sensor Fusion Technology*	-	25.724	28.672	25.458	-	25.458	24.400	24.714	28.243	28.808	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops the technologies required to perform management and fusion of sensor information for timely, comprehensive situational awareness, automatic target recognition, integrated fire control, and bomb damage assessment. This project determines the feasibility of technologies and concepts for fire control that help to precisely locate, identify, and target airborne and surface targets. The project emphasizes finding reduced signature targets and targets of opportunity. It will enable new covert tactics for successful air-to-air and air-to-surface strikes. This project also develops the technologies required to create trusted autonomic, distributed, collaborative, and self-organizing sensor systems that provide anticipatory and persistent intelligence, surveillance, and reconnaissance (ISR), situational awareness, and decision support for multi-layered sensing. This program provides the technologies for: 1) trusted sensors and trusted sensor systems that will deter reverse engineering and exploitation of our critical hardware and software technology and impede unwanted technology transfer, alteration of system capability, and prevent the development of countermeasures to U.S. systems; 2) collaborative tasking of our own distributed heterogeneous sensor networks across a region and co-opted tasking of both traditional and non-traditional adversary sensors; 3) secure sensor web backbone technologies, sensor web physical topologies, and related protocols to assure reliable trusted sensor interactions; and 4) defining architectures for distributed trusted collaborative heterogeneous sensor systems and semantic sensor networks, developing new methodologies for system of systems sensor engineering and analysis, and new techniques for sensor network situation awareness and predictive analytics.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Automatic Target Recognition Technologies	1.808	10.560	9.625
Description: Develop automatic target recognition (ATR), sensor management, and sensor fusion technologies for target detection, tracking, and identification in ISR, and combat identification applications.			
FY 2012 Accomplishments: Enhanced and assessed physics-based techniques to meet the target detection and identification requirements for ISR and combat identification applications. Conducted development and evaluation of automated battle space behavior analysis. Conducted development and assessment of technology that will fuse precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Enhanced multi-sensor, pixel level registration techniques as necessary to support requirements. Assessed and developed capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Conducted research of bio-inspired automatic target recognition technologies and assessed and evaluated these techniques for			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
all missions with emphasis on urban applications. Conducted assessment of automatic target recognition, sensor management, and sensor fusion algorithms for urban ISR from small remotely piloted aircraft (RPA). ***FY 2013 Plans:*** Enhance and assess physics-based techniques to meet the autonomous target detection and identification requirements for ISR applications. Enhance multisensor, pixel level registration techniques as necessary to support requirements. Continue to assess and develop capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy and autonomous sensor, processor, and bandwidth management. Continue research of bio-inspired automatic target recognition technologies and continue to assess and evaluate these techniques for all missions with emphasis on urban applications. Continue assessment in Planning & Direction, Collection, Processing and Exploitation, Analysis and Production, and Dissemination and Experimentation (PCPAD-X) integrative and virtual environments of automatic target recognition, sensor management, and sensor fusion algorithms for urban ISR. ***FY 2014 Plans:*** Assess and enhance physics-based techniques to meet the autonomous target detection and identification, sensor management, and sensor fusion requirements for intelligence, surveillance, and reconnaissance applications, combat identification applications, and PCPAD-X in contested and uncontested environments. Continue to assess and develop capabilities to represent and utilize sensor parameters and errors to improved fused geo-location accuracy. Continue research of bio-inspired automatic target recognition technologies.			
Title: Target Signature Modeling ***Description:*** Develop, evaluate, and demonstrate target signature models to support sensor exploitation algorithm development and testing for reconnaissance and strike mission applications. ***FY 2012 Accomplishments:*** Matured target signature models for signature exploitation of RF sensors, EO multi-spectral systems, and signals intelligence sensors emphasizing one target model for application to all parts of the spectrum. Developed signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology automatic target recognition of ground targets. Developed signatures, algorithms, target modeling, and phenomenological modeling of other phenomenological features not previously exploited. Generated synthetic air and ground target signatures with sufficient fidelity to support development and assessment of automatic recognition of targets in operationally realistic mission environments. Investigated model-driven spectral signal processing and exploitation techniques. Developed automatic target recognition algorithm-driven RF sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high-diversity data. Initiated measurements and prediction technology to analyze space object signatures in support of space situational awareness. ***FY 2013 Plans:***	4.449	4.845	4.180

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to mature target signature models for signature exploitation of RF sensors, EO multi-spectral systems, and signals intelligence sensors emphasizing one target model for application to all parts of the spectrum. Continue to develop signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology for automated sensor exploitation of ground targets. Continue the development of signatures, target modeling, and phenomenological modeling of other phenomenological features not previously exploited. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support development and assessment of automatic recognition of targets in realistic mission environments. Continue development of automatic target recognition algorithm-driven RF sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high-diversity data. ***FY 2014 Plans:*** Continue to mature target signature models for signature exploitation of multi-spectral systems and signals intelligence sensors emphasizing one target model for application to all parts of the spectrum. Continue the development of signatures, algorithms, target modeling, and phenomenological modeling of features not previously exploited. Continue development of automatic target recognition algorithm-driven radio-frequency sensor design.			
Title: Sensor Exploitation Technologies ***Description:*** Develop technical methods required for algorithm performance models, performance driven sensing, layered sensing and other sensing and exploitation technologies impacted by automated exploitation capabilities. ***FY 2012 Accomplishments:*** Conducted investigations of sensor exploitation techniques. Developed a capability to model the performance of these technologies. Validated algorithm performance models. Developed databases and tools required to support performance modeling and assessment. Enhanced development of an integrated, unified automatic target recognition methodology building upon the modeling and assessment tools developed. ***FY 2013 Plans:*** Continue development of a capability to model the performance of sensor exploitation technologies. Continue validation of algorithm performance models to be used in the PCPAD-X integrative and virtual environments. Continue development of databases and tools required to support performance modeling and assessment. Continue to enhance development of an integrated, unified automatic target recognition methodology building upon the modeling and assessment tools developed. ***FY 2014 Plans:***	5.887	7.564	6.778

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue development of performance models for sensor exploitation technologies, and associated databases and tools. Continue validation of algorithm performance models to be used in the PCPAD-X integrative and virtual environments. Continue to enhance development of an integrated, unified ATR methodology.			
Title: Trusted Sensing Technologies ***Description:*** Develop, evaluate, and demonstrate methodologies, techniques, and strategies to instill trust in distributed, heterogeneous sensing systems within air, space, and cyber domains. ***FY 2012 Accomplishments:*** Completed development of new technologies and methodologies for producing adaptive, assured, and trusted architectures for multilayered sensing. Developed advanced trusted sensing services, methodologies and techniques for acquisition, aggregation, and portrayal of critical data for sensing network situation awareness. Initiated development of methods, tools, and processes to determine and assess vulnerability and mission assurance for complex system-of-systems for spectrum warfare. ***FY 2013 Plans:*** Continue development of advanced trusted sensing services, middleware, and frameworks for multilayered sensing and spectrum warfare. Continue development of methods, tools, and processes to determine and assess vulnerability and mission assurance as a function of system scale in complex system-of-systems. Continue development of methods, tools, and processes to determine and assess vulnerability and mission assurance for complex system-of-systems for spectrum warfare. ***FY 2014 Plans:*** Continue development of advanced trusted sensing services, middleware, and frameworks for multilayered sensing and spectrum warfare. Continue development of methods, tools, and processes to determine and assess vulnerability and mission assurance for complex system-of-systems for spectrum warfare. Continue development of autonomic trusted sensor technologies to address self-aware, self-healing, and self-organizing sensor systems. Continue development of detect and response mechanism to remedy software and hardware supply chain vulnerabilities.	8.786	2.267	4.875
Title: Anti-Tamper Sensing Technologies ***Description:*** Develop technologies that enable autonomic trusted features in sensor systems to deter reverse engineering and exploitation of critical military hardware and software systems. ***FY 2012 Accomplishments:*** Developed integrated software protection and anti-tamper systems for multilayered ISR sensing systems and spectrum warfare applications. Developed key technologies for trusted sensors for multi-layered ISR sensing systems to assure anti-tamper and software protection of key military capabilities. Developed autonomic trusted sensor technologies to address self-aware, self-healing, and self-organizing sensor systems. Assessed and evaluated commercial technologies for application to military trusted	2.684	1.779	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
systems. Completed development of key technology experiments to demonstrate trusted sensor technologies on military weapon systems. ***FY 2013 Plans:*** Continue development of integrated software protection and anti-tamper systems for multilayered ISR sensing systems and spectrum warfare applications. Continue development of autonomic trusted sensor technologies to address self-aware, self-healing, and self-organizing sensor systems. Initiate development of detect and response mechanism to remedy software and hardware supply chain vulnerabilities. Initiate development of software protection and anti-tamper solutions that integrate universal situational awareness to improve attack monitoring and prediction capabilities. ***FY 2014 Plans:*** Efforts move to Thrust 4 - Trusted Sensing Technologies in this Project to better align efforts.			
Title: Multi-Layered Sensing Technologies ***Description:*** Develop trusted and assured avionics system network and integration technology, physical topologies, and protocols to support multi-layered sensing. ***FY 2012 Accomplishments:*** Developed avionics system vulnerability assessment testbed. Developed and assessed advanced avionics bus technologies for trusted sensing. Conducted analysis to exploit wired and wireless avionics sensor systems and analysis of technologies to protect and defend sensor systems. ***FY 2013 Plans:*** Continue development of avionics system vulnerability testbed. Complete development of advanced avionics bus technologies for trusted sensing. Continue analysis to exploit wired and wireless avionics sensor systems and begin analysis of technologies to protect and defend sensor systems. Initiate assessment of susceptibilities of commercial derivative avionics systems. ***FY 2014 Plans:*** Efforts move to Thrust 4 - Trusted Sensing Technologies in this Project to better align efforts.	2.110	1.657	0.000
Accomplishments/Planned Programs Subtotals	25.724	28.672	25.458

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
627622: *RF Sensors & Countermeasures Tech*	-	44.355	43.538	42.783	-	42.783	42.663	45.135	51.075	55.387	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops and assesses affordable, reliable all weather RF sensing and countermeasure concepts for aerospace applications covering the range of RF sensors including communications, navigation, ISR, and radar, both active and passive, across the air, land, sea, space and cyber domains. This project also develops and evaluates technology for ISR 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 RF signatures that are difficult to detect due to reduced radar cross sections, concealment and camouflage measures, severe clutter, or heavy jamming. Techniques exploited include the use of multiple RF phenomenologies, multi-dimensional adaptive processing, advanced waveforms and knowledge-aided processing techniques. This project also develops the RF warning and countermeasure technology for advanced 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 RF sensors, including radar warning, RF electronic warfare, and electronic intelligence applications.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Hybrid Sensor Technologies	2.620	5.524	7.839
Description: Develop hybrid sensor solutions to be responsive to needs and detect difficult targets. Develop jam-resistant time, position, and velocity sensors.			
FY 2012 Accomplishments: Developed strategies to optimize reference technologies for distributed sensing missions. Explored alternatives when GPS is degraded or denied. Reduced size, weight, and power of inertial components. Enhanced precision of GPS and non-GPS reference technologies.			
FY 2013 Plans: Continue to develop strategies to optimize reference technologies for distributed sensing missions. Explore alternatives when GPS is degraded or denied. Continue to reduce size, weight, and power of inertial components, while pursuing near navigation grade performance.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to develop strategies to optimize reference technologies for distributed sensing mission. Expand research of alternatives when GPS is degraded or denied in contested environments. Continue to reduce size, weight, and power of inertial components, while pursuing near navigation grade performance.			
Title: RF Sensor Technologies ***Description:*** Conduct applied research and development for the advancement of passive and active RF sensors; including phenomenology, modeling and simulation, algorithm development, and experimentation. Plan, execute, and maintain state-of-the-art RF sensor research and development facilities. ***FY 2012 Accomplishments:*** Completed Distributed Sensing Test Range. Upgraded Outdoor Range capabilities. Performed RF Sensing experimentation including sidelobe nulling, RF Tomography, and multispectral fusion (RF and EO/IR). Stood up X-Band multi-channel phased array radar capability. Began establishment of Open System Architecture for Outdoor Range operations. ***FY 2013 Plans:*** Continue research and development in dismount detection, sparse arrays, polarization diversity, RF tomography, multiple-inputs and multiple-outputs (MIMO) for EP, and Along Track Interferometry (ATI) for ground moving target indicator(GMTI). Continue outdoor range experimentation for concept verification and validation. Continue Outdoor Range Open System Architecture refinement and implementation. Establish new measurement capabilities at low (UHF) and high (Ku/Ka) frequency bands. ***FY 2014 Plans:*** Continue research and development in dismount classification, waveform diversity, MIMO for electronic protection and ATI for GMTI radar. Continue model development for MIMO and waveform diverse distributed sensing networks, and for airborne multi-static radar, illumination management and bi-static airborne early warning systems.	18.353	11.282	13.814
Title: Advanced RF Architectures ***Description:*** Develop active RF sensor solutions to use against difficult-to-detect targets in challenging environments, and advanced RF architectures for open and reconfigurable systems. Enable persistent ISR over wide areas, and detect advanced air and ground targets. ***FY 2012 Accomplishments:*** Developed and tested reconfigurable array manifold and initiate integration with multi-channel receiver for system demonstration. Tested reconfigurable architecture against multiple configurations and missions, and utilize active array and manifold in the research of advanced RF waveforms. ***FY 2013 Plans:***	1.158	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
N/A. Effort completed in FY12. ***FY 2014 Plans:*** N/A			
Title: Passive RF Sensor Technologies ***Description:*** Develop advanced techniques and prototype passive RF sensors to intercept, collect, locate and track enemy RF sensor systems for ISR of air and ground targets. ***FY 2012 Accomplishments:*** Developed requirements for passive millimeter wave RF receivers, antennas and signal processors. ***FY 2013 Plans:*** Develop signal obstacle course to verify tunable RF architecture using dynamic RF signals. This program will utilize in-house facilities, and state-of-art RF hardware deliverables from the Defense Advanced Research Projects Agency and Air Force contracts. ***FY 2014 Plans:*** Efforts move to Thrust 2 - RF Sensor Technologies in this Project to better align efforts.	0.222	1.518	0.000
Title: Optimize RF Sensing Technology ***Description:*** 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. ***FY 2012 Accomplishments:*** Initiated research and modeling of distributed and layered electronic warfare (EW) efforts (i.e., multiple jammers or jamming techniques) for spectrum warfare. Explored and analyzed a future/on-coming RF-based threat for potential counters and perform initial vulnerability assessment. Researched advanced electronic support (ES) concepts. Conducted the research and exploration of an adaptable ES/electronic attack (EA) capability, including the exploration of the synergy of a real-time ES system coupled with tailorable EA techniques. ***FY 2013 Plans:***	8.155	5.821	5.895

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue development of distributed and layered EW effects. Continue to explore and analyze future/on-coming RF-based threats for potential counters and perform vulnerability assessments. Continue to research advanced ES concepts. Complete research and exploration of an adaptable ES/EA capability. ***FY 2014 Plans:*** Initiate development of distributed and layered EW effects to maintain spectrum dominance for assured operations and position, navigation, and timing (PNT) in contested environments. Continue to explore and analyze next generation RF-based threats for potential counters and perform vulnerability assessments. Continue to research advanced ES concepts. Complete research and exploration of an adaptable ES/EA capability.			
Title: Multi-Band/Multi-Beam Technologies ***Description:*** Develop multi-band and multi-beam forming technologies. Address technologies for antenna array operations in dynamic sensor networks. ***FY 2012 Accomplishments:*** Further developed an electronic chassis framework (toolkit) for applying open architectures to Department of Defense sensing systems. Further developed and demonstrated a W-band solid state power amplifier for wideband satellite communications (SATCOM) applications. ***FY 2013 Plans:*** Develop RF/EO subsystem concept prototype and begin its development to validate trade space tools. Refine trade space analysis. ***FY 2014 Plans:*** Continue to develop RF/EO subsystem concept prototype and begin its development to validate trade space tools. Initiate trade space analysis for RF/EO subsystem and device concepts. Continue the development of MIMO and waveform-diverse system models for multi-sensor networks operating in contested environments containing complex clutter and multi-path. Continue the development of cognitive and phenomenology-based algorithm. Continue development of GPS and non-GPS navigation schemes for hypersonic vehicles.	10.397	7.093	5.891
Title: Complex Clutter Environments ***Description:*** Investigate detection of difficult airborne and ground-based targets in clutter from airborne or space-based surveillance platforms. ***FY 2012 Accomplishments:***	3.450	2.800	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Developed radar environment models for clutter rejection and multipath mitigation by combining electromagnetic phenomenology, cognitive algorithms and sensor signal processing pertaining to the detection and tracking of small targets in complex clutter and jamming environments for MIMO sensor network configurations. ***FY 2013 Plans:*** Continue the development of models applicable to MIMO and waveform-diverse systems for multi-sensor networks operating in complex clutter and multi-path environments, and further continue the development of cognitive and phenomenology-based algorithm theory for the detection and classification of difficult targets and dismount activities for persistent and ubiquitous coverage using multi-platform configurations. ***FY 2014 Plans:*** Efforts move to Thrust 6 - Multi-Band/Multi-Beam Technologies in this Project to better align efforts.			
Title: Counter RF Threat Technologies ***Description:*** Develop aerospace platform jamming technologies and techniques to counter advanced radio-frequency (RF)threats associated with current and future aerospace weapons systems. ***FY 2012 Accomplishments:*** N/A ***FY 2013 Plans:*** Initiate research on distributed and layered EW effects. Explore and analyze RF-based threats for potential counters and perform vulnerability assessments. Initiate research for advanced EW concepts. ***FY 2014 Plans:*** Continue to develop technologies that ensure unfettered access to the electromagnetic spectrum while denying the same to adversaries. Continue long-term research on integrating bio-inspired decision-making and cognitive capabilities to EW and EW battle management systems to improve responses in ambiguous EM environments.	0.000	9.500	9.344
Accomplishments/Planned Programs Subtotals	44.355	43.538	42.783

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF 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.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force											DATE: April 2013	
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)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	117.986	98.375	104.063	-	104.063	109.561	118.110	119.604	124.194	Continuing	Continuing
621010: *Space Survivability & Surveillance*	-	46.718	30.199	35.987	-	35.987	38.733	40.568	44.904	48.066	Continuing	Continuing
624846: *Spacecraft Payload Technologies*	-	24.743	22.336	19.122	-	19.122	20.243	20.192	21.793	22.169	Continuing	Continuing
625018: *Spacecraft Protection Technology*	-	9.436	4.230	5.423	-	5.423	7.269	7.803	6.439	6.367	Continuing	Continuing
628809: *Spacecraft Vehicle Technologies*	-	37.089	41.610	43.531	-	43.531	43.316	49.547	46.468	47.592	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This Program Element focuses on four major areas. First, space survivability and surveillance develops technologies to understand space weather and the geophysics environment for mitigation and exploitation of these effects to Air Force systems. Second, spacecraft payload technologies improve satellite payload operations by developing 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 and control technologies, and their interactions. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary space technologies.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force					DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*			R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*		
B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	115.158	98.375	109.644	-	109.644
Current President's Budget	117.986	98.375	104.063	-	104.063
Total Adjustments	2.828	0.000	-5.581	-	-5.581
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	3.466	0.000			
• SBIR/STTR Transfer	-0.638	0.000			
• Other Adjustments	0.000	0.000	-5.581	-	-5.581

Change Summary Explanation

Decrease in FY14 is due to higher DoD priorities.

Reprogrammed for specific projects in accordance with Section 219 of the Duncan Hunter National Defense Authorization Act for Fiscal Year (FY) 2009, as amended by Section 2801 of the National Defense Authorization Act for FY 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 621010: *Space Survivability & Surveillance*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
621010: *Space Survivability & Surveillance*	-	46.718	30.199	35.987	-	35.987	38.733	40.568	44.904	48.066	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops technologies to understand and control the space environment for warfighter's future capabilities. The focus is on characterizing and forecasting the battlespace environment for more realistic space system design, modeling, and simulation, as well as the battlespace environment's effect on space systems' performance. This includes technologies to specify and forecast the space environment for planning operations, ensure uninterrupted system performance, optimize space-based surveillance operations, and provide capability 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Space Environment Research	7.963	6.344	6.409
Description: Develop technologies for specifying, monitoring, predicting, and controlling space environmental conditions hazardous to DoD operational space systems.			
FY 2012 Accomplishments: Completed improved database for solar flare prediction tool. Developed a new instrument to measure energetic electrons, ions, and neutral atoms in low earth orbit (LEO). Refined and expanded models of the radiation belts based on anticipated data sets from planned space flight experiment.			
FY 2013 Plans: Refine the concept-of-operations for solar optical flare specification and prediction unit, and complete the setup of the associated solar optics laboratory. Explore properties of spacecraft materials and novel coatings to understand effects of temperature and aging on spacecraft charging and develop new techniques for charge mitigation. Continue development of space environment models and tools to support improved spacecraft design and space mission planning.			
FY 2014 Plans: Continue energetic space particle dynamics research to improve quality of spacecraft environmental hazard predictions. Continue spacecraft material temperature, dose, and aging effects research. Develop spacecraft charge mitigation techniques related to on-orbit material aging. Develop next-generation miniaturized space environment sensor concepts. Exploit developing solar ultraviolet emissions and solar wind models to enable a time-dependent solar wind model capable of handling transients.			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 621010: *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Investigate potential alternatives to traditional solar flare specification and prediction to achieve more accurate predictions. Develop improved solar radio frequency monitoring concepts.			
Title: Surveillance Technologies	11.368	6.169	9.546
Description: Develop advanced target detection techniques, spectral signature libraries, and decision aids for space-based sensors and surveillance systems. ***FY 2012 Accomplishments:*** Investigated space-based hypertemporal (HT) detection methods and data processing. Investigated utilization of HT detection methods for monitoring concealed activity. Continued to develop a search sensor system to monitor and characterize resident space objects and maneuver signatures. Refined concepts and applications for space-based thermal infrared (IR) hyperspectral imaging payloads. Developed atmospheric compensation and temperature-emissivity separation models for space-based thermal infrared hyperspectral imaging. ***FY 2013 Plans:*** Evaluate space-based HT sensor performance. Complete HT data processing methodology and continue investigation of HT detection methods for concealed activity monitoring. Continue trade-space studies of components used in space-based thermal IR hyperspectral imaging payloads. Begin development of case scenarios and sensitivity analyses of atmospheric compensation and temperature-emissivity separation codes required for space-based thermal IR hyperspectral imaging. ***FY 2014 Plans:*** Continue to support development, calibration, data exploitation, and deployment for multiple types of hyperspectral sensors. Continue space-based HT sensor performance trade studies. Continue evaluation of HT detection methods for concealed activity monitoring. Develop and test new temperature emissivity separation and atmospheric compensation algorithms to enable future space-based long wave IR hyperspectral sensors.			
Title: Ionospheric Research	9.656	6.640	7.005
Description: Develop techniques, forecasting tools, and sensors for ionospheric specification and forecasting, space-based geolocation demonstrations, and determination of potential radar degradation. ***FY 2012 Accomplishments:*** Investigated methods to exploit grid-free calculations of plasma processes in the magnetosphere and ionosphere, as well as in the solar atmosphere and solar wind. Studied energy flow between solar and terrestrial environments to improve solar weather			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 621010: *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
forecasts. Studied plasma instabilities and plasma processes in the equatorial and solar ionospheres. Incorporated coupled physics-based models into space weather forecasts. ***FY 2013 Plans:*** Incorporate methods to exploit grid-free calculations of plasma processes in the magnetosphere and ionosphere to improve solar weather forecasts. Begin modeling energy flow between solar and terrestrial environments. Study plasma instabilities and processes in the equatorial ionosphere to predict global positioning system and communication impacts. Develop plan for increased measurement capabilities in severely under-sampled region for more accurate predictions of communication/navigation effects. Begin development of physics-based LEO satellite drag prediction tool. ***FY 2014 Plans:*** Continue investigations for physics-based improvements of space weather forecast models. Develop improved scintillation specification and forecast capability for communication and global positioning system (GPS) impacts by assimilating space, ground and other unexploited data sources. Begin implementing plan for increasing measurements in under-sampled regions for more accurate prediction of communications and GPS degradation. Validate preliminary LEO satellite drag prediction tool and improve by assimilating satellite observations. Begin study of auroral clutter effects on radar systems.			
Title: Radiation Remediation Research ***Description:*** Conduct Radiation Belt Remediation (RBR) and ionospheric research at the High-frequency Active Auroral Research Program (HAARP) site. ***FY 2012 Accomplishments:*** Conducted applications-related demonstrations exploiting ionosphere ducts for very long-range, beyond the horizon, communications and surveillance purposes. Conducted research to characterize the interactions of radio waves and charged particles in the earth's radiation belts, to assess the planned Demonstration and Science Experiment (DSX) satellite experiments. Developed RBR end-to-end model and validated to improve understanding of wave particle interaction, space transmitter, and lightning phenomenology. Investigated options for future use of HAARP. ***FY 2013 Plans:*** Continue to characterize the interactions of radio waves and charged particles in the earth's radiation belts, to assess planned DSX satellite experiments. Apply understanding of very low frequency (VLF) propagation from space sources and the resulting wave particle interactions. Continue developing a validated end-to-end model to assess the feasibility of a fielded RBR system. ***FY 2014 Plans:***	11.332	4.850	3.161

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 621010: *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue ground-based VLF propagation experiments using national and international assets. Validate revised VLF ionospheric propagation models for RBR modeling to include natural and man-made VLF sources. Incorporate results from planned VLF and particle mapping flight experiment to support ground-based and space-based VLF transmitter experiments.			
Title: Seismic Technologies ***Description:*** Develop seismic technologies to support national requirements for monitoring nuclear explosions with special focus on regional distances less than 2,000 kilometers from the sensors. ***FY 2012 Accomplishments:*** Completed refinement of unified model results of seismic calibration and observational studies of seismic wave propagation, including propagation in Eurasia. Evaluated the results of using three-dimensional earth models in test processing of seismic events for some regions of high interest. Tested potential improvements in high-frequency regional discrimination. Continued detailed studies of particular challenge areas in local seismic monitoring. ***FY 2013 Plans:*** Migrate unified models of seismic calibration and wave propagation in Eurasia to three-dimensional physics-based models. Begin to extend coverage of unified model to all of Eurasia. Test new processing approaches to image local seismic structure. ***FY 2014 Plans:*** Improve resolution of three-dimensional physics-based seismic wave propagation models through scientific and computational advances. Investigate use of these three-dimensional models to match all details of seismic signals. Continue extending coverage of unified model throughout Eurasia.	6.399	6.196	5.782
Title: Alternative Navigation Technologies ***Description:*** Develop new technologies based on cold atom physics that provide autonomous jam-proof precision inertial navigation to augment GPS in case of GPS-denial. Develop atomic clocks based on new technologies to replace legacy GPS atomic clocks. ***FY 2012 Accomplishments:*** N/A ***FY 2013 Plans:*** N/A ***FY 2014 Plans:*** Design a compact atomic clock that would provide both the accuracy and robustness necessary to replace legacy atomic clocks for GPS with modern sustainable technology. Begin construction of a free space cold atom gyroscope/accelerometer that	0.000	0.000	4.084

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
would enable GPS-free precision navigation. Evaluate design of a confined cold atom gyroscope to reduce size and weight requirements to expand GPS-free navigation to a larger number of Air Force platforms.			
Accomplishments/Planned Programs Subtotals	46.718	30.199	35.987

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 624846: *Spacecraft Payload Technologies*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
624846: *Spacecraft Payload Technologies*	-	24.743	22.336	19.122	-	19.122	20.243	20.192	21.793	22.169	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 development of advanced, space-qualified, survivable electronics, and electronics packaging technologies; development of advanced space data generation and exploitation technologies, including infrared sensors; and development of high-fidelity space simulation models that support space-based surveillance and space asset protection research and development for the warfighter.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Space-Based Detector Technologies	8.039	4.432	4.477
Description: Develop advanced infrared device technologies that enable hardened space detector arrays with improved detection to perform acquisition, tracking, and discrimination of space objects and missile warning.			
FY 2012 Accomplishments: Evaluated performance of advanced high operating temperature infrared devices exposed to radiation environment; made data and analysis available to academia, industry, and government. Evaluated in-house fabricated tunable detector samples to demonstrate proof-of-concept. Investigated tunable filters, developing code and simulations for absorbing pulses in preparation for experimental verification. Initiated silicon-based, hardened and extended response photodetector arrays effort leveraging low-cost silicon materials to detect further in the infrared than state-of-the-art. Completed investigation of imaging and tracking for space situational awareness (SSA).			
FY 2013 Plans: Continue predictive capability for next generation large format detector array and readout array technology challenges toward Wide Area, Global Access Detection and Tracking. Continue developing alternative, lower-cost detector materials that operate at higher temperatures for the persistent surveillance mission. Explore theoretical and experimental electronic transport and tenability studies in semiconductors to improve detector sensitivity and operation.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 624846: *Spacecraft Payload Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Develop innovative components and technologies to enable new capabilities or enhance existing performance of space sensors. Pursue revolutionary breakthroughs to improve target detection and identification, enable mission configurability, and provide all weather, all terrain, dim/distant target detection and identification while reducing the volume, weight and cost.			
Title: Space Situational Awareness Sensing Research ***Description:*** Develop innovative means for measuring, modeling, and predicting phenomena for SSA and protection applications. Develop new methods to evaluate how well specific data contributes to identifying particular physical and functional information about a space-based object, and ultimately enable decision-makers to pursue courses of action. ***FY 2012 Accomplishments:*** Furthered analysis, modeling, and bench-top experiments in new sensing methods, including radio and IR bands, polarimetry, and non-traditional interferometric techniques. Developed a new method for mapping decision-maker information needs to sensing capability needs, including quality, quantity, and timeliness measures of effectiveness. ***FY 2013 Plans:*** Initiate predictive modeling capabilities for select sensing methods and phenomena. Develop theory required and apply to a variety of space awareness mission threads and potential threat scenarios. Verify and validate decision-critical information mapping exercise results. Complete the multi-sensor exploitation for space object characterization effort. ***FY 2014 Plans:*** Verify and validate predictive modeling capabilities against laboratory and field measurements. Initiate next-generation analysis of sensing methods and phenomena to exploit for space protection.	5.021	6.228	4.036
Title: Space Electronics Research ***Description:*** Develop technologies for space-based payload components such as radiation-hardened electronic devices, micro-electro-mechanical system devices, and advanced electronics packaging. ***FY 2012 Accomplishments:*** Investigated high power microwave hardening techniques for satellite systems to develop methodologies to mitigate against narrowband high power microwaves over a wide frequency range. Began research on advanced system-on-chip integration for improved performance of space sensor systems. Completed development of radiation hardened plug-and-play interface module for reconfigurable spacecraft hardware. Initiated development of integrated modules using three-dimensional techniques to reduce size, weight, and power and increase performance. ***FY 2013 Plans:***	6.882	5.493	4.924

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 624846: *Spacecraft Payload Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue investigation of hardening techniques to protect satellites from high power microwaves. Continue research on advanced system-on-chip integration for improved performance of space sensor systems. Continue development of integrated modules using three-dimensional techniques to reduce size, weight, and power and increase performance. ***FY 2014 Plans:*** Complete investigation of hardening techniques to protect satellites from high power microwaves. Complete integration model of basic technologies for proof-of-concept system-on-chip integration. Continue research and development of advanced system-on-chip integration for improved performance of space sensor systems. Complete three-dimensional evaluation test devices to prove feasibility of the process within the foundry. Continue development of integrated modules using three-dimensional techniques to reduce size, weight, and power and increase performance. Begin investigating multicore processor architectures for integration with three-dimensional and system-on-chip techniques.			
Title: Modeling and Simulation Tools for Space Applications ***Description:*** Develop modeling and simulation tools for space-based ground surveillance systems, rendezvous and proximity operations, imaging of space systems, distributed satellite architecture, and space control payloads. ***FY 2012 Accomplishments:*** Developed engineering and military utility models for space superiority analysis of SSA and defensive operations technologies. Supported autonomous space flight experiments with cost modeling and trade studies. ***FY 2013 Plans:*** Continue to refine and test spacecraft simulations that model system performance, mission planning, and experiments for future flight experiments. Develop a data center to be able to archive telemetry from flight experiments. Note: Increase in funding is due to additional emphasis on modeling and simulation technologies supporting Defensive Space Control and SSA. ***FY 2014 Plans:*** Continue to develop spacecraft and mission simulations in close conjunction with customers across DoD. Integrate state-of-the-art system performance and mission planning algorithms into modeling and simulation software tools. Transition validated tools to the data center in preparation for upcoming flight programs.	4.294	6.183	5.685
Title: Space Communication Technologies ***Description:*** Develop technologies for next-generation space communications terminals and equipment and methods/techniques to enable future space system operational command and control concepts. ***FY 2012 Accomplishments:***	0.507	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Researched technologies/components that support optical communication, reconfigurable and cognitive communication, advanced radio frequency (RF) communication, and communication security to increase the capacity and flexibility of current and future space protected communication system concepts. ***FY 2013 Plans:*** This effort has been moved to Project 628809 to better align with Air Force science and technology goals. ***FY 2014 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	24.743	22.336	19.122

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 625018: *Spacecraft Protection Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
625018: *Spacecraft Protection Technology*	-	9.436	4.230	5.423	-	5.423	7.269	7.803	6.439	6.367	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops the technologies for protecting U.S. space assets in potentially hostile environments to assure continued space system operation without performance loss in support of warfighter requirements. The project focuses on identifying and assessing spacecraft system vulnerabilities, developing threat warning technologies, and developing technologies to mitigate the effects of both intentional and unintentional threats.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Threat Warning Research	9.436	4.230	5.423

Description: Develop satellite threat warning technologies and tools for space defense. Exploit on-board inherent satellite resources, satellite-as-a-sensor, and self-aware satellite technologies.

FY 2012 Accomplishments:
Developed technologies for on-orbit threat detection, assessment, and response, including development of algorithms for pursuit-evasion, space-based tasking, and co-orbital threat detection. Baselined all-in-all satellite conjunction analysis system. Developed net-centric situation awareness system. Reduced size, weight, and power requirements for next-generation proximity detection sensors. Note: In FY 2012, increased emphasis on threat warning technologies.

FY 2013 Plans:
Continue technology development of advanced on-orbit threat detection, assessment, and response, including data processing and handling for course of action determination, space-based tasking, co-orbital threat detection, and autonomous response. Demonstrate situational awareness system in operational environment. Develop and obtain initial operating capability for situational awareness testbed. Reduce size, weight, and power for next-generation proximity detection sensors.

FY 2014 Plans:
Enhance satellite-as-a-sensor technology development. Demonstrate improved ability to determine satellite orbital conjunctions and develop proof-of-concept for closed loop situational awareness system. Develop integrated sensor and response system for threat detection, characterization, and warning. Advance detection sensor technology to improve data-to-information-to-

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 625018: *Spacecraft Protection Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
decision capabilities. Develop improved sensor algorithms and data fusion techniques. Continue to reduce size, weight, and power requirements for next generation proximity detection sensors.			
Accomplishments/Planned Programs Subtotals	9.436	4.230	5.423

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 628809: *Spacecraft Vehicle Technologies*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
628809: *Spacecraft Vehicle Technologies*	-	37.089	41.610	43.531	-	43.531	43.316	49.547	46.468	47.592	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Space Power/Thermal Research	7.734	5.773	5.444

Description: Develop technologies for advanced space platform subsystems such as cryocoolers, compact, high efficiency solar power cells and arrays, and innovative power generation concepts.

FY 2012 Accomplishments:

Began effort to increase cryocooler efficiency from 12% to 30% through in-house modeling, energy analysis of single and multi-stage coolers, and distributed cooling. Began to research effective low and zero vibration cryocooler technologies, including solid state coolers. Modeled spacecraft thermal radiation signature phenomenology to understand the physics of IR sensing of resident space objects. Advanced development of materials and concepts for 40% efficiency or greater solar cells. Demonstrated cell interconnect and module technologies to enable flexible arrays.

FY 2013 Plans:

Continue to increase cryocooler efficiency from 12% to 30% through modeling, energy analysis of single and multi-stage coolers, and cross gimbal/distributed cooling. Continue to research effective low and zero vibration cryocooler technologies, including solid state coolers. Continue to investigate approaches and concepts for development of greater than 40% efficient solar cells. Continue development of novel flexible array technologies to enable greater launch volume stowage efficiency.

FY 2014 Plans:

Complete preliminary cryocooler modeling, energy analysis of single and multi-stage coolers, and cross gimbal/distributed cooling to improve cryocooler efficiency and demonstrate some strategies. Continue to research and advance effective low and zero vibration cryocooler technologies, including solid state coolers. Begin moving forward with maturation of most promising technical

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 628809: *Spacecraft Vehicle Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
approaches for greater than 40% efficient solar cells. Continue development of novel flexible array technologies to enable greater launch volume stowage efficiency and higher specific power.			
Title: Space Structures and Controls Research	11.301	9.891	10.711
Description: Develop revolutionary and enabling technologies, including lighter weight, lower cost, high performance structures for space platforms; guidance, navigation, and controls hardware and software for next generation of space superiority systems. ***FY 2012 Accomplishments:*** Completed integrated thermal management subsystem for satellites applications. Developed novel technologies for high-efficiency deployable structures for RF frequencies and electro-optical payloads for SSA. Developed automated guidance, navigation, and control subsystem design tools for spacecraft. Initiated development of advanced estimation-based algorithms for search, detect and track of space objects. Initiated new dynamics analysis efforts for prediction of spacecraft relative motion and development of improved navigation system and maneuver detection methods. Initiated efforts to produce improved spacecraft thruster dynamic response models to allow increased precision in relative-motion control applications. Initiated development of next-generation electronics to enable more rapid spacecraft build and to reduce spacecraft cost. Developed technologies for integrated satellite bus checkout and sensor calibration using autonomous flight architecture. ***FY 2013 Plans:*** Produce experimental flight hardware for thermal management systems requiring high power input. Develop capabilities for characterizing novel, structural materials in a relevant environment. Complete design tools for automated guidance, navigation, and control subsystem for spacecraft. Demonstrate and transition advanced estimation-based algorithms for search, detect, and track of space objects. Continue development of advanced dynamic analysis methods for spacecraft relative motion applications; validate improved spacecraft thruster models in relevant environment; initiate new techniques supporting debris mitigation, including passive (fuel free) techniques for de-tumbling debris to allow for easier removal; initiate new research in collaborating autonomous spacecraft guidance, navigation, and control techniques supporting distributed spacecraft missions. Continue development of next-generation electronics to enable rapid spacecraft build and reduce spacecraft cost. Demonstrate autonomous flight architecture enabling rapid threat detection and response. ***FY 2014 Plans:*** Perform multi-physics characterization of relevant and non-linear structural materials (mechanical, thermal, electromagnetic). Produce flight hardware for experimental de-orbit mechanism for satellites and rocket stages. Complete advanced dynamics analysis methods efforts and demonstrate in relevant environment(s); continue space debris mitigation efforts; continue collaborative autonomous spacecraft guidance, navigation, and control efforts supporting distributed spacecraft missions; initiate			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 628809: *Spacecraft Vehicle Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
efforts to integrate guidance, navigation, and control methods with advanced spacecraft autonomy decision architectures. Demonstrate on the ground space-to-space surveillance system with autonomous sensor control.			
Title: Space Experiments ***Description:*** Develop flight experiments to improve the capabilities of existing operational space systems and to enable new transformational space capabilities. ***FY 2012 Accomplishments:*** Completed assembly, integration, and test of the DSX satellite to launch ready. Continued operations concept planning and continued development, design, and build of DSX mission planning tools for on-orbit operations. ***FY 2013 Plans:*** Begin launch readiness preparations, electrical trailblazer, insertion of flight batteries and communications security equipment, and regression testing with satellite operations center in preparation for integration on the launch vehicle. ***FY 2014 Plans:*** Continue pre-launch preparations and pre-launch-vehicle integration for on-orbit radiation remediation proof-of-concept experiment. Develop innovative technologies for planned on-orbit experiment using the Evolved Expendable Launch Vehicle Secondary Payload Adaptor to support both platform and payloads, as well as developing advanced interfaces to accommodate partner payloads and technologies. Complete manufacturing and delivery of very low frequency particle mapper (VPM) payload suite, and begin satellite bus integration. Begin VPM mission launch readiness actions.	18.054	20.389	21.245
Title: Space Communication Technologies ***Description:*** Develop technologies for next-generation space communications terminals and equipment and methods/techniques to enable future space system operational command and control concepts. ***FY 2012 Accomplishments:*** N/A ***FY 2013 Plans:*** Conduct research and develop various technologies (i.e., high power amplifiers, integrated optical transceivers, high-performance satellite antenna, and reconfigurable satellite radios) to support future space communication systems; particular emphasis is placed on optical (laser) communication, reconfigurable and cognitive communication, advanced radio frequency communication, high-bandwidth photonic satellite bus networks, and satellite communication security/encryption. ***FY 2014 Plans:***	0.000	5.557	6.131

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601F: *Space Technology*	PROJECT 628809: *Spacecraft Vehicle Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue applied research and development efforts (modeling, simulation, and laboratory testing) to reduce component technical risks (e.g., functionality and performance) and to meet technology and capability needs for optical (i.e., laser communication), millimeter-wave (i.e., Ka-band, V-band, W-band), and protected satellite communication technology.			
Accomplishments/Planned Programs Subtotals	37.089	41.610	43.531

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*					R-1 ITEM NOMENCLATURE PE 0602602F: *Conventional Munitions*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	60.725	77.175	81.521	-	81.521	84.722	86.942	91.146	93.448	Continuing	Continuing
622068: *Advanced Guidance Technology*	-	20.732	32.955	32.801	-	32.801	33.261	35.741	37.065	38.297	Continuing	Continuing
622502: *Ordnance Technology*	-	39.993	44.220	48.720	-	48.720	51.461	51.201	54.081	55.151	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program investigates, develops, and establishes the technical feasibility and military utility of guidance and ordnance technologies for conventional air-launched munitions. Program supports core technical competencies of fuze technology; energetic materials; damage mechanisms; munitions aerodynamics and guidance, navigation, and control; terminal seeker sciences; and munition systems effects. Technologies to be developed include blast, fragmentation, penetrating and low-collateral damage warheads, hard target fuzing, precise terminal guidance, and high performance and insensitive explosives. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. 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 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	60.656	77.175	84.162	-	84.162
Current President's Budget	60.725	77.175	81.521	-	81.521
Total Adjustments	0.069	0.000	-2.641	-	-2.641
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	0.704	0.000			
• SBIR/STTR Transfer	-0.635	0.000			
• Other Adjustments	0.000	0.000	-2.641	-	-2.641

Change Summary Explanation

Decrease in FY 2014 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602602F: *Conventional Munitions*	PROJECT 622068: *Advanced Guidance Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
622068: *Advanced Guidance Technology*	-	20.732	32.955	32.801	-	32.801	33.261	35.741	37.065	38.297	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project investigates, develops, and evaluates conventional munitions guidance technologies to establish technical feasibility and military utility of innovative munition seekers, weapon aerodynamics, navigation and control, and guidance subsystem integration/simulation. Project payoffs include adverse-weather, networked, and autonomous precision munition 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Seeker Technologies	2.016	3.500	6.800
Description: Develop seeker technologies for air-delivered munitions to provide high confidence target discrimination and classification, precise target location, and robust terminal tracking. ***FY 2012 Accomplishments:*** Continued laboratory development and evaluation of test components for laser ranging, improved multi-mode, adverse weather synthetic aperture and high resolution radar modes seekers. Began technology development of very low-cost, adverse weather capable, radar seeker for small weapons. Developed theory for seeker sensor fusion and autonomous target recognition, and studied multi-weapon and conformal apertures for enhanced resolution and beam forming on small cooperative weapons. Continued applying the neurophysiology of insects to guide small vehicles to moving targets, investigated guidance technologies that optimize delivery of selectable effects munitions through countermeasures and developed dual mode seeker for hypersonic environments and discriminating tunnels and surface aimpoints for boosted/high-speed penetrators. ***FY 2013 Plans:*** Develop technologies that simplify, increase the flexibility, and reduce the cost of passive and active electro-optical, infrared, and radar munition seekers, with focus on combat operations in adverse weather and in high-speed engagements. Increase emphasis on seeker technologies that provide enhanced mission capability for fifth-generation aircraft, specifically as it applies to success in denied or anti-access environments. Continue developing algorithms and processing technologies to acquire and track targets			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602602F: *Conventional Munitions*	PROJECT 622068: *Advanced Guidance Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
with and without an operator in the loop. Continue pursuing revolutionary bio-inspired seeker technologies to increase immunity to countermeasures, to exploit multi-discriminant signatures, and to reduce the size and cost of detectors. ***FY 2014 Plans:*** Increase emphasis in developing technologies that simplify, increase the flexibility, and reduce the cost of passive and active electro-optical, infrared, and radar munition seekers, with focus on combat operations in adverse weather and in high-speed engagements. Continue to emphasize development of seeker technologies that provide enhanced mission capability for fifth-generation aircraft, specifically as it applies to success in denied or anti-access environments. Develop algorithms and processing technologies to acquire and track targets with and without an operator in the loop. Increase emphasis on revolutionary bio-inspired seeker technologies to increase immunity to countermeasures, to exploit multi-discriminant signatures, and to reduce the size and cost of detectors. Increase emphasis on high-resolution wide field of view sensors, particularly with bio-inspired and high rate processing characteristics.			
Title: Aerodynamics, Navigation and Control Technologies ***Description:*** Develop advanced weapon aerodynamic, control, navigation, and networking technologies for air-delivered munitions to provide precise, agile flight, networked effects, and immunity to countermeasures. ***FY 2012 Accomplishments:*** Continued developing weapon airframe and control concepts to achieve high levels of agility and maneuverability, developing multi-functional structures, and evaluating navigation mode with other systems. Continued developing nonlinear, robust control methodologies for future weapons, such as high-speed terminal guidance on long-range strike weapons and control and actuation technologies for boosted penetrator systems within Global Positioning System (GPS) jamming environments. Continued development of algorithms to use wide field-of-view optical imager data, enabling navigation under GPS-denied conditions. Developed highly compact, high throughput avionics processors, and continued maturing technologies allowing weapons to communicate and exploit information in a secure, low probability of detection. ***FY 2013 Plans:*** Continue developing technologies that achieve precision navigation under GPS-degraded and GPS-denied conditions. Identify and pursue additional weapon navigation and control networking technologies that provide enhanced mission capability in denied or anti-access environments. These technologies facilitate agile and maneuverable weapons, foster autonomy, trust, and networking, and enable precise munition control and actuation, especially for boosted penetrating munitions or during high-speed engagements. Increase emphasis in trusted terminal guidance and targeting flexibility/autonomy after long ingress & high attrition. ***FY 2014 Plans:*** Further develop technologies that achieve precision navigation under GPS-degraded and GPS denied conditions. Develop weapon navigation and control networking technologies that provide enhanced mission capability in denied or anti-access	9.298	20.000	19.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602602F: *Conventional Munitions*	PROJECT 622068: *Advanced Guidance Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
environments, facilitate agile and maneuverable weapons, foster autonomy, trust, and networking, and enable precise munition control and actuation, especially for munitions during high speed engagements. Investigate multi-functional, multi-strategy weapon swarms to defeat enemy defenses.			
Title: Guidance Technologies ***Description:*** Develop guidance subsystem integration and evaluation technologies to provide open and closed loop ground testing, flight test risk reduction, and digital simulation of novel concepts. ***FY 2012 Accomplishments:*** Investigated precision guided munition integration technology issues and functionality in various flight environments and refined the set of interoperable simulations to evaluate emerging munitions technologies. Simulated inventive concepts and approaches in guidance and control technology. Developed capability to test and refine development programs and future weapon concepts in a realistic operational environment. Continued multi-weapon search and attack technologies on a time critical moving target. Began build-up of test technologies for evaluating higher speed weapon guidance subsystems. ***FY 2013 Plans:*** Develop precision guided munition integration technology issues and functionality. Expand efforts to develop the capability to simulate, test, and refine pioneering seeker concepts and navigation and control approaches in a realistic operational environment. Increase emphasis on guidance integration and evaluation technologies that provide enhanced mission capability for fifth-generation aircraft. Continue pursuing multiweapon search and attack technologies on a time critical moving target. Continue the build-up of test technologies for evaluating higher speed weapon guidance subsystems. ***FY 2014 Plans:*** Develop precision guided munition integration technology and functionality. Focus on capabilities to simulate, test, and refine seeker concepts and navigation and control approaches in a realistic operational environment. Continue emphasis on guidance integration and evaluation technologies that provide enhanced mission capability for fifth-generation aircraft. Develop modeling techniques and tools to evaluate integrated, multi-weapon, and swarming search and attack. Develop test technologies for evaluating higher speed weapon guidance subsystems.	9.418	9.455	7.001
Accomplishments/Planned Programs Subtotals	20.732	32.955	32.801

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602602F: *Conventional Munitions*	PROJECT 622068: *Advanced Guidance 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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602602F: *Conventional Munitions*	PROJECT 622502: *Ordnance Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
622502: *Ordnance Technology*	-	39.993	44.220	48.720	-	48.720	51.461	51.201	54.081	55.151	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project investigates, develops, and evaluates conventional ordnance technologies to establish technical feasibility and military utility for advanced explosives, fuzes, warheads, submunitions, and weapon airframes, carriage, and dispensing. 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Energetic Materials Technology	7.659	11.000	10.000
Description: Investigate and develop energetic materials technology that can maximize weapon lethality, while applying appropriate safety and security features. ***FY 2012 Accomplishments:*** Tested and modeled explosive fills that reduce pre-detonation during high "G" loading. Developed low-density energetic materials for micro-munitions applications. Investigated high-density case materials to tailor or improve warhead performance. ***FY 2013 Plans:*** Develop, model, and test explosive fills that reduce pre-detonation during high "G" loading. Continue developing low density energetic materials for small munition applications. Exploit new nanoenergetic materials to enhance and tailor explosive effects. Increase emphasis on developing energetic materials that enable increased capability and capacity for fifth-generation aircraft. ***FY 2014 Plans:*** Continue to develop, model, and test explosive fills that reduce pre-detonation during high "G" loading. Further develop low density energetic materials for small munition applications. Exploit new nanoenergetic materials to enhance and tailor explosive effects. Emphasize development of energetic materials that improve performance and reduce bomb and missile size to increase loadout.			
Title: Fuze Technologies	8.359	10.700	13.800

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602602F: *Conventional Munitions*	PROJECT 622502: *Ordnance Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: Investigate and develop fuzes for air-delivered weapon applications to develop novel energetic initiation concepts, penetration fuzing, point burst fuzes, and develop predictive models. ***FY 2012 Accomplishments:*** Investigated novel methods to initiate explosives, including new modeling and testing techniques. Continued to investigate and characterize the mechanical environment that a fuze must survive during hard target penetration events. Explored ground profiling imaging fuze technology and developed a hardened chip fuze that uses integrated logic. ***FY 2013 Plans:*** Expand effort to investigate novel methods to initiate explosives, including new modeling and testing techniques. Increase emphasis on fuze technologies that enable increased capacity and capability of fifth-generation aircraft, specifically as it facilitates success in denied or anti-access environments. Continue to investigate and characterize the mechanical environment that a fuze must survive during hard target penetration events. Continue to explore ground profiling imaging fuze technology, and develop a hardened chip fuze that uses integrated logic. ***FY 2014 Plans:*** Improve modeling and testing techniques to investigate novel methods to initiate explosives, to include distributed and embedded fuzing concepts. Emphasize development of fuze technologies that enable increased capacity and capability of fifth-generation aircraft, specifically as it facilitates success in denied or anti-access environments. Continue to investigate and characterize the mechanical environment that a fuze must survive during hard target penetration, and explore ground profiling imaging fuze technology.			
Title: Warhead Technologies ***Description:*** Investigate and develop innovative warhead kill mechanisms, such as adaptable warheads, directional-control fragmenting warheads, and reactive metals. ***FY 2012 Accomplishments:*** Developed compact lethality warhead technologies for use in urban terrain. Continued investigating directional warhead concepts employing reactive fragments to improve standoff kills for non-direct hit encounters. Continued developing numerical algorithms for material-to-material interface dynamics, loading, and vibration during high speed penetration. Investigated techniques to control, direct, and focus the energy release from explosives in real-time by means of applying small amounts of electromagnetic energy. Investigated novel warhead designs that provide warfighting capability to deliver selectable effects on targets ***FY 2013 Plans:***	11.182	13.000	13.900

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602602F: *Conventional Munitions*	PROJECT 622502: *Ordnance Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue developing novel warhead technologies, especially those that enable small, agile munitions or that provide the capability to deliver selectable effects on targets. Continue investigating directional warhead concepts to improve standoff kills for non-direct hit encounters by employing reactive fragments or by utilizing a forward focusing fragment capability. Continue developing tools to better predict material-to-material interface dynamics, loading, and vibration during high-speed penetration. ***FY 2014 Plans:*** Increase emphasis in developing warhead technologies, especially those that enable munition agility, variable effects, and improved energy coupling. Continue investigating directional warhead concepts to improve standoff kills for non-direct hit encounters by employing reactive fragments or by utilizing a forward focusing fragment capability. Continue developing tools to better predict material-to-material interface dynamics, loading, and vibration during high-speed penetration.			
Title: Ordnance Technologies ***Description:*** Using a system approach, investigate and develop ordnance concepts by making technology trades between fuzes, warheads, and explosives and by improving weapon carriage, release, and dispensing. ***FY 2012 Accomplishments:*** Investigated precision guided munition integration issues and functionality in various flight environments. Continued building and using interoperable simulations to evaluate emerging technologies. Continued developing and enhancing new models and improvements for micromunitions, penetrators, and counter-chemical, biological, radiological, and nuclear effects. ***FY 2013 Plans:*** Continue investigation of precision guided munition integration issues and functionality in various flight environments. Continue building and using interoperable simulations to evaluate emerging technologies. Continue developing and enhancing new models and improvements for small munitions, penetrators, and counter chemical, biological, radiological, and nuclear effects. Increase emphasis on ordnance concepts that increase the capacity and capability of fifth-generation aircraft. ***FY 2014 Plans:*** Continue to investigate precision guided munition integration issues and functionality in various flight environments, and continue building and using interoperable simulations to evaluate emerging technologies. Continue developing technologies to improve models for small munitions, penetrators, and counter chemical, biological, radiological, and nuclear effects. Develop ordnance concepts that increase the capacity and capability of fifth-generation aircraft.	12.793	9.520	11.020
Accomplishments/Planned Programs Subtotals	39.993	44.220	48.720

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602602F: *Conventional Munitions*	PROJECT 622502: *Ordnance Technology*

C. Other Program Funding Summary ($ in Millions)

Remarks

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*					R-1 ITEM NOMENCLATURE PE 0602605F: *Directed Energy Technology*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	139.769	106.196	112.845	-	112.845	128.153	122.534	121.315	123.677	Continuing	Continuing
624866: *Lasers & Imaging Technology*	-	113.429	78.211	79.798	-	79.798	83.247	82.323	83.499	85.144	Continuing	Continuing
624867: *Advanced Weapons & Survivability Technology*	-	26.340	27.985	33.047	-	33.047	44.906	40.211	37.816	38.533	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program covers research in directed energy (DE) technologies, primarily high energy lasers, including devices, optical beam control, and integration; ground-based optical space situational awareness (SSA); and high power electromagnetics. Laser research includes moderate to high power laser devices that are applicable to a wide range of applications, optical technologies to propagate lasers beams from a device, and integration of these technologies. In SSA, this research uses the Starfire Optical Range and the Maui Space Surveillance System to develop and implement technologies to identify status, health, etc. of orbiting space objects. In high power electromagnetics, this research examines technologies for applications such as counter-electronics and non-lethal weapons. Research into other novel DE applications will be conducted. DE vulnerability/lethality assessments are conducted and protection technologies are developed. Research into other advanced non-conventional/innovative weapons will be conducted. Tools are developed and used to compare solutions and to determine the most effective and efficient DE technologies to meet Air Force needs. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. 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 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602605F: *Directed Energy Technology*

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	141.078	106.196	115.779	-	115.779
Current President's Budget	139.769	106.196	112.845	-	112.845
Total Adjustments	-1.309	0.000	-2.934	-	-2.934
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	0.536	0.000			
• SBIR/STTR Transfer	-1.845	0.000			
• Other Adjustments	0.000	0.000	-2.934	-	-2.934

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2012	FY 2013
Project: 624866: *Lasers & Imaging Technology*		
Congressional Add: *Space Situational Awareness.*	30.000	0.000
Congressional Add Subtotals for Project: 624866	30.000	0.000
Congressional Add Totals for all Projects	30.000	0.000

Change Summary Explanation

Decrease in FY14 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602605F: *Directed Energy Technology*	PROJECT 624866: *Lasers & Imaging Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
624866: *Lasers & Imaging Technology*	-	113.429	78.211	79.798	-	79.798	83.247	82.323	83.499	85.144	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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. This project investigates the effects of laser weapons on a wide range of systems and components as well as producing, modifying, validating and applying DE and non-DE concept development and assessment tools to determine which technology solutions to pursue. Research supporting ground-based optical space situational awareness is conducted.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: High Energy Laser Technologies and Directed Energy Assessments	53.338	50.101	52.244

Description: Develop and demonstrate high energy laser device technologies for Air Force applications. Develop and demonstrate optical laser beam control technologies including atmospheric compensation and pointing and tracking. Perform laser system level modeling and simulation validated by laser effects and vulnerability testing. Develop tools and perform assessments which allow comparisons among DE concepts and tradeoffs between DE and non-DE solutions. Integrate optical beam control technologies with laser device technologies and demonstrate the combined technologies. Develop and use technologies to better understand the vulnerability of weapon systems to lasers.

FY 2012 Accomplishments:

Conducted research supporting design and fabrication of weapons-class laser components, including hybrid and fiber lasers, for potential inclusion on an aircraft. The Flowing Diode Pumped Alkali Laser (DPAL) reached the goal of 250 Watts (a new record) of output power. Developed 500 Watt peak power optically-pumped semiconductor laser in the mid-infrared (eye-safer) wavelength. Conducted laboratory testing of horizontal propagation compensation concepts and began planning for field testing. Prepared technologies to support a demonstration of a high power solid state laser with a beam control system on the ground. Successfully completed 30 high energy laser engagements against targets of interest under flight conditions, to include 11 Navy targets to measure laser damage thresholds and material properties of target components and to increase confidence in vulnerability predictions.

FY 2013 Plans:

Develop new method of fabricating and producing quantum cascade lasers (mid-to long-wavelength infrared) to enable greater than five times improvement in brightness over commercially available sources. Scale pulsed optically-pumped semiconductor

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602605F: *Directed Energy Technology*	PROJECT 624866: *Lasers & Imaging Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
laser in the mid-infrared (eye-safer) wavelength to kilowatt-class peak power. The Flowing DPAL effort will complete design work on a new laser head that will protect the device windows from Rubidium (Rb) contamination, enabling higher laser performance. Begin design, integration, and testing of selected components and subsystems for an electric laser system to operate in an airborne environment. Reduce the linewidth of the monolithic fiber amplifier in the laboratory to five gigahertz with a power output of over 900 Watts with good beam quality. This is approximately three times narrower than the linewidths of commercial amplifiers. Demonstrate technologies to support pointing and tracking of targets for a ground based demonstration. Evaluate and integrate horizontal propagation compensation concepts for field testing. Conduct beam control research in support of a demonstration of a high power solid state laser with a beam control system on the ground. Develop models incorporating aero-effects on laser beams projected from the beam control system. Conduct effects testing to establish requirements for aircraft self-protection laser system. ***FY 2014 Plans:*** Continue to conduct research supporting a joint Air Force/DARPA ground demonstration of a high power solid state laser with a beam control system. Prepare for flight tests of beam control technologies. Continue integration and begin testing of horizontal propagation compensation concepts. Develop analysis tools including platform, optics, controls, atmospheric effects, and target predictions supporting future weapons analysis. Conduct effects testing to establish system requirements and validate modeling efforts.			
Title: Optical Space Situational Awareness and Satellite Vulnerability ***Description:*** Develop advanced, long-range, electro-optical technologies that support ground-based optical space situational awareness. Develop and use technologies to better understand the vulnerability of blue satellite systems to lasers. ***FY 2012 Accomplishments:*** Developed dim object detection and analysis capability to determine geosynchronous satellite characteristics. Initiated transition of automated satellite characterization tools to AF customers. ***FY 2013 Plans:*** Improve satellite characterization tools, developing algorithms to determine attitude and shape of satellites in geosynchronous orbit. Develop initial capabilities for extending existing imaging techniques into 24-hour operations. Demonstrate the ability to image space objects during extended daylight hours using the 3.6-meter telescope, enabling the observation of objects in orbit that cannot be viewed at night for the first time. ***FY 2014 Plans:*** Demonstrate capability to determine orientation of geosynchronous satellites. Demonstrate use of laser guidestar to enable detection of objects the size of a basketball in close proximity to geosynchronous satellites. Develop data analysis techniques to understand and keep track of potential threat objects in space. Demonstrate capabilities for extending existing techniques	30.091	28.110	27.554

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602605F: *Directed Energy Technology*	PROJECT 624866: *Lasers & Imaging Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
into 24-hour operations. Develop and use technologies to quantify the vulnerability and protection needs of certain blue satellite components.			
Accomplishments/Planned Programs Subtotals	83.429	78.211	79.798

	FY 2012	FY 2013
Congressional Add: Space Situational Awareness. ***FY 2012 Accomplishments:*** Conducted research supporting space situational awareness. ***FY 2013 Plans:*** N/A	30.000	0.000
Congressional Adds Subtotals	30.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
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: *Advanced Weapons & Survivability Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
624867: *Advanced Weapons & Survivability Technology*	-	26.340	27.985	33.047	-	33.047	44.906	40.211	37.816	38.533	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project explores high power electromagnetic (HPEM) applications and other unconventional/innovative weapon concepts to support applications such as non-lethal counterpersonnel and disruption, degradation, and damage of electronic infrastructure. This research will allow most effects to be covert with no collateral structural or human damage. This project also investigates the effects of potential HPEM weapons and mitigation of HPEM effects. HPEM includes but is not limited to high power microwaves and millimeter waves.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: HPEM and Unconventional Weapon Technologies	17.049	17.367	19.933
Description: Investigate technologies for HPEM components. Investigate HPEM and other unconventional weapon concepts using innovative technologies. Investigate advanced technologies that support force protection tactical applications, including non-lethal counter-personnel applications. ***FY 2012 Accomplishments:*** Investigated technologies to enhance standoff capabilities of microwave components used for electronic attack. Conducted high energy density plasma experiments. Improved HPM source design software input-file suite for a new HPM source that can produce multi-gigawatts of power in a smaller volume and provide longer range and higher probability of effects for the next generation counter-electronics HPM systems. ***FY 2013 Plans:*** Develop technologies to provide frequency agile, broadband sources. Develop state-of-the-art components to shrink antennas, microwave components, and energy storage/prime power technologies. ***FY 2014 Plans:*** Begin integration of state-of-the-art components to shrink antennas, microwave sources, and energy storage/prime power systems. Investigate technologies to provide frequency agile, broadband sources. Conduct assessments on the feasibility of particle beam weapons for counter-electronics.			
Title: HPEM Effects and Mitigation Research	9.291	10.618	13.114

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
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: *Advanced Weapons & Survivability Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: Assess the effects/lethality of HPEM technologies. Develop and apply sophisticated models to enhance the development of HPEM and related technology. Investigate technologies to counter the effects of HPEM. ***FY 2012 Accomplishments:*** Investigated mitigation effects of HPEM on U.S. systems of interest including modern tactical aircraft components. Updated models based on latest experimental HPEM data. ***FY 2013 Plans:*** Investigate effects of high bandwidth technologies, exploring issues to exploit/prevent cyber-attack. Develop smart waveform technologies and techniques as well as predictive effects methodologies. ***FY 2014 Plans:*** Begin incorporating effects of high bandwidth and smart waveform technologies and techniques into numerical simulations. Begin funding the Air Force portion of the High Power Microwave Software Applications Institute (HSAI). This is an Air Force/DoD High Performance Computing Modernization Program for the development of advanced, user friendly, modeling and simulation capability for entire HPM systems.			
Accomplishments/Planned Programs Subtotals	26.340	27.985	33.047

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*					R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	139.980	104.362	138.161	-	138.161	147.826	150.057	151.068	153.931	Continuing	Continuing
625315: *Connectivity and Protection Tech*	-	64.025	40.834	57.471	-	57.471	63.486	64.805	62.705	61.619	Continuing	Continuing
625316: *Info Mgt and Computational Tech*	-	31.789	27.030	25.862	-	25.862	29.602	30.224	30.019	30.779	Continuing	Continuing
625317: *Information Decision Making Tech*	-	18.709	15.787	15.775	-	15.775	14.666	15.046	14.295	14.611	Continuing	Continuing
625318: *Operational Awareness Tech*	-	25.457	20.711	20.604	-	20.604	21.324	20.855	24.474	27.026	Continuing	Continuing
62OMMS: *Research Site Support*	-	0.000	0.000	18.449	-	18.449	18.748	19.127	19.575	19.896	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 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 deter any adversary from attacking computer systems while allowing access to, presence on, manipulation of, and operational effects on adversary computer systems. This project also develops the technology base for the next generation of ultra-wide-bandwidth, multi-channeled, air- and space-based communications networks. The Information Management and Computational Tech project provides advances in 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 Air Force systems. The Information Decision Making Tech project develops the technology to support the commander and staff's 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 their capability to generate, process, manage, fuse, exploit, interpret, and disseminate timely and accurate information. This program has been coordinated through the the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, since it develops and demonstrates the technical feasibility and military utility of evolutionary and revolutionary technologies.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	127.855	104.362	115.129	-	115.129
Current President's Budget	139.980	104.362	138.161	-	138.161
Total Adjustments	12.125	0.000	23.032	-	23.032
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	13.385	0.000			
• SBIR/STTR Transfer	-1.260	0.000			
• Other Adjustments	0.000	0.000	23.032	-	23.032

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2012	FY 2013
Project: 625315: *Connectivity and Protection Tech*		
Congressional Add: *Cyber Security Research*	12.000	-
Congressional Add Subtotals for Project: 625315	12.000	0.000
Congressional Add Totals for all Projects	12.000	0.000

Change Summary Explanation

In FY 2014, increase is due to Project 62OMMS, Research Site Support being included due to additional civilian end strength, and realignment of research site support efforts to this PE.

Received realignment of Congressional Add from PE 0601103F University Research Initiative; Reprogrammed for specific projects in accordance with Section 219 of the Duncan Hunter National Defense Authorization Act for Fiscal Year (FY) 2009, as amended by Section 2801 of the National Defense Authorization Act for FY 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625315: *Connectivity and Protection Tech*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
625315: *Connectivity and Protection Tech*	-	64.025	40.834	57.471	-	57.471	63.486	64.805	62.705	61.619	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

The Air Force requires technologies that enable assured, worldwide communications among all elements of the force. These communication technologies will provide en-route and deployed reachback communications for distributed collaborative military operations. 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 technology base for the next generation of ultra-wide bandwidth, multi-channeled air- and space-based communications networks on and between platforms. In addition, the Air Force requires technologies to deliver a full range of options in cyberspace on par with air and space dominance in each of the areas of cyber attack, cyber defense, and cyber support to achieve the strategic capability of cyber dominance. This project provides the technologies required to successfully deter any adversary from attacking computer systems anytime, anywhere by ensuring the Air Force's ability to: access, maintain presence on, and deliver effects to adversary systems; detect, defend, and respond to attacks on friendly computer systems as well as provide forensic analysis concerning those attack attempts; and provide cyber situational awareness to Air Force commanders.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Advanced Connectivity Technologies	11.147	9.927	24.137
Description: Develop improved, survivable, higher bandwidth communications, networking, and signal processing technologies to provide secure, adaptive, covert, anti-jam, and assured global battlespace connectivity tailored to anti-access and area denial environments and contested operations.			
FY 2012 Accomplishments: Conducted in-house and university development of next generation advanced networking technologies for distributed military operations in an airborne environment. Developed secure video distribution over tactical internets on demand, and designed optimized, distributed, cross-layer protocol stacks for cognitive radio ad hoc networks with decentralized control. Investigated spatial multiplex multiple-input and multiple-output (MIMO) techniques to increase channel capacity, and developed a cognitive cooperation protocol for wireless networks. Completed development of capability for increased V/W bandwidth communication and characterization to a variety of airborne platforms with varying data rates. Completed investigation of mission essential			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625315: *Connectivity and Protection Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
functions, including mini-CDL, assessing threat tolerance in contested environments, and developing mitigation strategies to alleviate risk due to cyber vulnerabilities. ***FY 2013 Plans:*** Continue development of next generation advanced networking technologies for distributed military operations in an airborne environment. Continue both development of secure video distribution over tactical internets on demand and design of distributed, cross-layer protocols for cognitive radio ad hoc networks with decentralized control. Complete investigation of spatial multiplex MIMO techniques to increase channel capacity and the development of a cognitive cooperation protocol for wireless networks. ***FY 2014 Plans:*** Continue development of next generation advanced networking technologies for distributed military operations in an airborne environment. Continue both development of secure video distribution over tactical internets on demand and design of distributed, cross-layer protocols for cognitive radio ad hoc networks with decentralized control. Initiate the development of a modular airborne network bridge for the creation of an air-air/air-ground secure tactical intranet. Initiate the development of wideband, long-range, rapidly deployable aerial backbone network for command, control, intelligence, surveillance, and reconnissaince (C2ISR) dissemination. Initiate research in support of the development of a protected, wide-band satellite communication architecture.			
Title: Cyber Defense Technologies ***Description:*** Develop cyber defense and supporting technologies to detect, defend, and respond to attacks on computer systems as well as provide forensic analysis concerning the attacks. ***FY 2012 Accomplishments:*** Developed technology to assure operations of our networked forces (a trusted execution environment) in high threat, contested cyber environments by demonstrating a trusted cyber delivery vehicle/platform to support nearly all types cyber operations. Completed development of technologies to support the ability to avoid cyber attacks by increasing redundancy, diversity, and agility in Air Force networks to disrupt adversary attack planning by pursuing defensive cyber maneuver and agility, polymorphic code development, and concealment and obfuscation of our networks. ***FY 2013 Plans:*** Continue development of technology to assure operations of our networked forces (a trusted execution environment) in high threat, contested cyber environments by demonstrating a trusted cyber delivery vehicle/platform to support nearly all types cyber operations. ***FY 2014 Plans:*** Continue development of technology to assure operations of our networked forces (a trusted execution environment) in high threat, contested cyber environments by demonstrating a trusted cyber delivery vehicle/platform to support nearly all types of	8.600	14.131	21.212

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625315: *Connectivity and Protection Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
cyber operations. Complete development of advanced data assurance and threat mitigation technologies. Initiate development of technologies to support cyber missions' ability to keep pace with rapidly changing next-generation communications networks/ devices and deliver a full range of cyber effects.			
Title: Cyber Offense Technologies	19.309	9.877	11.347
Description: Develop offensive cyber operations technologies to access, maintain presence on, and deliver effects to adversary systems. ***FY 2012 Accomplishments:*** Developed information system access methods and propagation techniques. Developed stealth and persistence technologies and initiated investigation into anti-reverse engineering methods. Developed the capability to exfiltrate information from adversary information systems, developed methods for increased cyber situational awareness and understanding of the battlefield, and developed methods for covert data exchange. Developed technology to deliver D5 (decieve,degrade, deny, disrupt, destroy) effects in concert with cyber platforms. Initiated development of a publish/subscribe architecture for exchange and exfiltration of information while operating within adversary information systems. ***FY 2013 Plans:*** Complete development of information system access methods and development of propagation techniques. Continue development of stealth and persistence technologies. Continue investigation into anti-reverse engineering methods. Continue development of methods for increased cyber situational awareness and understanding of the battlefield, and continue the development of methods for covert data exchange. Complete development of technology to deliver D5 effects in concert with cyber platforms. Continue development of a publish/subscribe architecture for exchange and exfiltration of information while operating within adversary information systems. ***FY 2014 Plans:*** Continue development of stealth and persistence technologies. Continue investigation into anti-reverse engineering methods. Continue development of methods for increased cyber situational awareness and understanding of the battlefield, and continue the development of methods for covert data exchange. Continue development of a publish/subscribe architecture for exchange of information. Initiate the development of a common operating platform for Air Force operational cyber missions.			
Title: Survivability Technologies	5.876	6.899	0.775
Description: Develop methods and technologies for controlled operation of information systems during attacks and fault conditions, minimizing vulnerabilities of cyber attacks, and guaranteeing the accuracy and correctness of data and codes. ***FY 2012 Accomplishments:***			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625315: *Connectivity and Protection Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Completed development of methods for disruption of malware and covert channels in data transmissions without having to detect whether malware or covert channels exist in the transmission. Initiated development of defensive cyber technologies to increase system survivability while under a cyber attack. Completed development of a resilient and self-regenerating information enterprise and developed automatic machine regeneration of software to recover with immunity from cyber attack. Conducted challenge problem in-house and university research investigations for development of cyber domain capabilities supporting Air Force information systems, including research in assured cyber operations in complex networks. Completed investigation of information assurance tenents in infrastructure as a service cloud environments, concentrating on ensuring secure processing, data storage and communication in a cloud. Developed defensive techniques for wireless, mobile, and embedded systems with vulnerability analysis and threat identification for emerging commercial wireless standards. ***FY 2013 Plans:*** Continue development of defensive cyber technologies to increase system survivability while under a cyber attack. Continue challenge problem in-house and university research investigations for development of cyber domain capabilities supporting Air Force information systems including research in assured cyber operations in complex networks. Continue investigation into secure processing by using hardware techniques and logic reconfiguration to drastically reduce major vulnerabilities. ***FY 2014 Plans:*** Complete development of defensive cyber technologies to increase system survivability while under a cyber attack. Complete challenge problem in-house and university research investigations for development of cyber domain capabilities supporting Air Force information systems including research in assured cyber operations in complex networks. Complete investigation into secure processing by using hardware techniques and logic reconfiguration to drastically reduce major vulnerabilities.			
Title: Next Generation Communications ***Description:*** Develop and assess wideband network technologies for application in the air and space environment, including existing and emerging modulation schemes and protocols and consisting of high capacity radio frequency (RF) and optical technologies, for next generation platform communications. ***FY 2012 Accomplishments:*** Initiated development of an all-optical communications system for airborne and satellite platforms, that can distribute very high rate digital data and RF signals in high shock, vibration, and radiation environments. Initiated development of next generation of high capacity data links supporting transmission requirements of airborne and spaceborne sensors. Conducted ground tests of RF waveform generation to demonstrate high capacity persistent sensor data transmission. ***FY 2013 Plans:***	7.093	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625315: *Connectivity and Protection Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
N/A. Effort terminated due to higher Department of Defense priorities. ***FY 2014 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	52.025	40.834	57.471

	FY 2012	FY 2013
Congressional Add: Cyber Security Research	12.000	-
FY 2012 Accomplishments: Conducted Congressionally directed cyber security research program.		
Congressional Adds Subtotals	12.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625316: *Info Mgt and Computational Tech*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
625316: *Info Mgt and Computational Tech*	-	31.789	27.030	25.862	-	25.862	29.602	30.224	30.019	30.779	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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: computer architectures with greater capacity and sophistication for addressing constrained, dynamic mission objectives; "game-changing" computing power to the warfighter; disruptive computing power at the tactical edge and for federated grid services; and interactive 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Dissemination Technologies	6.357	6.476	6.484
Description: Investigate and develop technologies for decision quality information dissemination services via publish, subscribe, and query across the Global Information Grid (GIG) to enterprise and tactical assets and coalition partners.			
FY 2012 Accomplishments: Developed tools and safeguards required to quickly and reliably transfer information from a higher classification domain to a lower classification domain, as well as to coalition partners. Completed research of service oriented architecture (SOA) based architectures and services for tactical and enterprise environments that are secure, survivable, and resilient to cyber attack and failures.			
FY 2013 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625316: *Info Mgt and Computational Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue development of tools and safeguards required to quickly and reliably transfer information from a higher classification security-domain to a lower classification security-domain, as well as to coalition partners. Initiate research into mission responsive data systems by mapping mission requirements to information flows. ***FY 2014 Plans:*** Demonstrate a multi-faceted approach to design, develop, and demonstrate a wide range of capabilities intended to protect information services and make them resilient to adverse conditions including cyber attack. Continue research into scalable mission responsive data systems by mapping mission requirements to information flows. Continue development and design of cloud-based information management services for provisioning sufficient computational power for high demand semantic processing of large data sets within mission timeline constraints. Initiate development of responsive autonomous control for tactical sensor control.			
Title: Processing Technologies ***Description:*** Develop automatic and dynamically reconfigurable, affordable, scalable, distributed petaflop processing technologies for real-time global information systems. ***FY 2012 Accomplishments:*** Developed next generation advanced computing techniques, enabling superior information processing for Air Force warfighters through in-house and university research. Completed study of reconfigurable electronics to enable intelligent Air Force systems to perform autonomous operations. Developed tools to analyze codes and dynamic execution profiles and extract threads suitable for multi-core computation. Completed development of advanced processing capabilities to enable the collection and processing of information as close to the sensor as feasible. Developed embedded processing for on-demand and multi-core petaflops computing. Conducted study of quantum cores as the foundational building blocks for a multi-core quantum processor. ***FY 2013 Plans:*** Continue development of next generation advanced computing techniques, enabling superior information processing for Air Force warfighters through in-house and university research. Complete development of tools to analyze codes and dynamic execution profiles and extract threads suitable for multi-core computation. Continue development of petaflops embedded processing on-demand and multi-core computing by demonstrating increased control of power of fabricated prototype. Complete study of quantum cores as the foundational building blocks for a multi-core quantum processor. ***FY 2014 Plans:*** Continue development of next generation advanced computing techniques, enabling superior information processing for Air Force warfighters through in-house research. Continue development of petaflops embedded processing on-demand and multi-core computing by demonstrating increased control of power of fabricated prototype. Demonstrate a context and content-aware trusted	14.146	11.155	10.354

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625316: *Info Mgt and Computational Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
router and a secure processor with hardware roots of trust. Demonstrate affordable, high performance, interactive and massively parallel computing architectures for intelligent and timely decision making for increased warfighter awareness.			
Title: Cross Domain Technologies ***Description:*** Develop secure cross domain discovery services for access to services outside of existing domain. Develop the tools to allow collaboration of workflows required by the Air Force net-centric information management environment. ***FY 2012 Accomplishments:*** Initiated development of an automated security annotation framework that provides safeguarding mechanisms for the AF enterprise. Completed an open architecture for the efficient integration of sensors, algorithms, and computing and communications hardware to support real-time tactical information collection, exploitation, and command and control. Completed development of advanced technologies to effectively manage large data storage warehouses within agile enterprise environments by developing quality of service enabled information management services coupled to network routing and management for tactical edge IP-based networks. Developed novel information management techniques as applied to all domains through in-house and university research leading to enhanced information flow across the net-centric assets of the GIG. Continue to develop information management capabilities in support of force protection. ***FY 2013 Plans:*** Continue development of an automated security annotation framework that provides safeguarding mechanisms for the Air Force enterprise. Continue development of novel information management techniques as applied to all security-domains through in-house and university research leading to enhanced information flow across the net-centric assets of the GIG. ***FY 2014 Plans:*** Continue development of an automated security annotation framework that provides safeguarding mechanisms for the Air Force enterprise. Continue development of novel information management techniques as applied to all security-domains through in-house and university research leading to enhanced information flow across the net-centric assets of the GIG. Enable Voice-Over-IP (VOIP) and video tele-confrence (VTC) content filters for allowing real time domain voice and video communications across coalition partners. By 2015 incrementally deliver a suite of new US/coalition collaboration services producing four new cross-domain capabilities (voice/video; full motion video streaming; automated content inspection; and global trusted remote management). Initiate development and demonstration of multi-level security trust, speed, & cost advancements for Global Network Operations Access/Connectivity.	4.485	4.543	4.690
Title: Advanced Architectural Technologies ***Description:*** Develop the architectural mechanisms that form the basis for predictable software and high assurance systems. ***FY 2012 Accomplishments:***	6.801	4.856	4.334

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625316: *Info Mgt and Computational Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Initiated development of architectures for a compact large array of many node clusters with very low power demand for intelligent systems. Completed development of trusted, automated cyber defense capability to reduce response time down to milli-seconds vice hours. Developed a co-design of a multi-core Tagged Secure Processor, a Zero-Kernel Operating System, and Application Development Environment inherently resistant to malicious software and inherently compliant with Multiple Independent Levels of Security (MILS) systems. Designed a hybrid complementary metal oxide semiconductor (CMOS)/memristor logic unit that is compact and efficient for encryption algorithm implementation. Developed tools, techniques, standards, and technologies required to build highly complex software-intensive systems including correct concurrent code for trusted embedded multi-core systems.			
FY 2013 Plans: Complete development of a trusted, automated cyber defense capability to reduce response time down to milliseconds vice hours. Continue the development of the tools, techniques, standards, and technologies required to build highly complex software-intensive systems. Complete development of a co-design of a multi-core Tagged Secure Processor, a Zero-Kernel Operating System, and Application Development Environment inherently resistant to malicious software and inherently compliant with MILS systems. Complete design of a hybrid CMOS/memristor logic unit that is compact and efficient for encryption algorithm implementation.			
FY 2014 Plans: Continue the development of the tools, techniques, standards, and technologies required to build highly complex software-intensive systems. Continue research to reduce power draw of embedded systems to enable sufficient performance to achieve autonomy and/or more on board processing. Complete design of foundations for trustworthy computing systems.			
Accomplishments/Planned Programs Subtotals	31.789	27.030	25.862

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625317: *Information Decision Making Tech*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
625317: *Information Decision Making Tech*	-	18.709	15.787	15.775	-	15.775	14.666	15.046	14.295	14.611	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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. Technology development in this project includes 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Campaign Planning Technologies	8.348	8.108	8.051
Description: Develop next generation monitoring, planning, and assessment technologies enabling aerospace commanders to develop effects-based campaigns. ***FY 2012 Accomplishments:*** Initiated development of a hybrid wargaming concept of decision theory and game theory to provide safeguarded courses of action (COA) in adversarial environments with varying degrees of partial information. Completed development and demonstrated 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. Investigated full-spectrum, quantitative analysis techniques that aid operational assessor's ability to link actions to effects to desired objectives. Developed and demonstrated decision workflow and workload management capabilities to analyze and prioritize courses of action for space control missions and space situational awareness. ***FY 2013 Plans:*** Continue development of decision theory and initiate the development of a capability for autonomous adaptive re-planning in a real-time simulation environment using a case-based planning system. Continue investigation of full-spectrum, quantitative analysis techniques that aid operational assessor?s ability to link actions to effects to desired objectives. Initiate development of robust autonomous control algorithms for heterogeneous and distributed assets capable of learning in dynamic environments. ***FY 2014 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625317: *Information Decision Making Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue development of decision theory and continue the development of a capability for autonomous adaptive re-planning in a real-time simulation environment using a case-based planning system. Continue investigation of full-spectrum, quantitative analysis techniques that aid operational assessor's ability to link actions to effects to desired objectives. Continue development of robust autonomous control algorithms for heterogeneous and distributed assets capable of learning in dynamic environments.			
Title: Command and Control System Technologies ***Description:*** Investigate, analyze, and develop technologies for planning, execution, and automatic rapid reconfiguration of distributed intelligent and integrated command and control (C2) information systems to achieve the commander's intent throughout varying crisis levels. ***FY 2012 Accomplishments:*** Developed capabilities to be more agile within a net centric enabled environment by developing models of cyber network attacks to enable better operation of cyber assets with air and space assets. Completed development of a cooperative multi-agent system to maximize sensor task completions and provide an adaptive and flexible solution to deal with the dynamics of new asset task allocations. Conducted in-house 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. ***FY 2013 Plans:*** Complete development of capabilities to be more agile within a net-centric enabled environment by developing models of cyber network attacks to enable better operation of cyber assets with air and space assets. Continue in-house 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 Air Force forces. Continue development of techniques for visualizing cyber situational awareness, appropriately selecting cyber assets to achieve desired effects and assuring Operations Center functionality while under cyber attack. ***FY 2014 Plans:*** Continue in-house 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 Air Force forces. Continue development of techniques for visualizing cyber situational awareness, appropriately selecting cyber assets to achieve desired effects and assuring Operations Center functionality while under cyber attack. Initiate research and development of algorithms for obtaining a comprehensive situational awareness and timely execution assessment to achieve desired effects.	10.361	7.679	7.724
Accomplishments/Planned Programs Subtotals	18.709	15.787	15.775

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625317: *Information Decision Making Tech*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625318: *Operational Awareness Tech*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
625318: *Operational Awareness Tech*	-	25.457	20.711	20.604	-	20.604	21.324	20.855	24.474	27.026	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

The Air Force requires technologies that improve and automate the 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 situational awareness, understanding, and anticipation of the threats in the battlespace, 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 identification (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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Multi-Source Fusion Technologies	14.201	10.188	11.286
Description: Develop higher-level fusion and the enabling text information/knowledge base technologies to achieve situational awareness and understanding at all command levels for dynamic planning, assessment, and execution processes.			
FY 2012 Accomplishments: Developed implementation of techniques to increase the scalability of tracking algorithms from 10's to 1000's of ground targets in a large rural-urban environment. Initiated development of techniques for performing indications and warnings, pattern recognition, and information fusion for information exploitation. Developed techniques and algorithms to improve analysis of multi-sensor data for mining data across multi-INT repositories for behavioral patterns to identify terrorist networks, track movement, and process moving-target indication data from airborne sensors, and automatically classify airborne targets, including RPA. Completed design and demonstration of an automated feature aided tracking and pattern recognition capability for onboard processing of high-resolution, wide-area video staring sensor with cueing from lower bandwidth sensors. Conducted in-house and university research dealing with level 1 - 4 fusion using multi-source intelligence and sensor feeds to advance the Air Force capability to anticipate the variety of threats from the ground, air, and cyber domains. Completed development of techniques for analyzing and assessing activities to support situation assessment. Initiated developing software to aid the analyst in determining the entity's behavior, including direction, speed, maneuvers, and operation of equipment. Completed development of automated generation			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625318: *Operational Awareness Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
of ontology from free-text or heterogeneous data sources, and automated task suggestion in response to requests for intelligence information and assessments. ***FY 2013 Plans:*** Complete development and implementation of techniques to increase the scalability of tracking algorithms from 10's to 1000's of ground targets in a large rural-urban environment. Continue development of techniques for performing indications and warnings, pattern recognition, and information fusion for information exploitation. Complete development of techniques and algorithms to improve analysis of multi-sensor data for mining data across multi-INT repositories for behavioral patterns to identify terrorist networks and track movement and that process moving-target indication data from airborne sensors, and automatically classify airborne targets, including RPA. Continue in-house and university research dealing with level 1 - 4 fusion using multi-source intelligence and sensor feeds to advance the Air Force capability to anticipate the variety of threats from the ground, air, and cyber domains. Continue developing software to aid the analyst in determining the entity's behavior, including direction, speed, maneuvers, and operation of equipment. ***FY 2014 Plans:*** Continue development of techniques for performing indications and warnings, pattern recognition, and information fusion for information exploitation. Continue in-house and university research dealing with level 1-4 fusion using multi-source intelligence and sensor feeds to advance the Air Force capability to anticipate the variety of threats from the ground, air, and cyber domains. Continue developing software to aid the analyst in determining the entity's behavior, including direction, speed, maneuvers, and operation of equipment. Continue research into machine learning to improve Planning and Direction, Collection, Processing and Exploitation, Analysis and Production, and Dissemination (PCPAD). Develop text analysis capabilities enabling analysts to efficiently: extract/consolidate info from massive amounts of textual data; ID enemy entity-relation networks from that info, and develop/ maintain an understanding of the networks over time. Develop Activity-Based Intelligence capabilities capable of characterizing and locating activities and transactions.			
Title: Exploitation Technologies ***Description:*** Develop digital information exploitation technologies for electronic communications and special signals intelligence, imagery, and measurement signatures to increase accuracy, correlation, and timeliness of the information. ***FY 2012 Accomplishments:*** Completed the development and evaluation of watermarking techniques, focusing on streaming media. Completed investigation of combined temporal, spatial, and frequency techniques to provide a multi-domain approach for information provenance, pedigree, and assurance. Developed, tested, and evaluated real-time, tactical information exploitation software using laboratory tools and operational data. Developed a wide variety of exploitation methods to enhance signals situational awareness. Conducted in-house and university research in advanced exploitation techniques that maximize the Air Force ability to gather, process, and	8.249	9.574	6.176

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625318: *Operational Awareness Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
display information from multi-INT sources identifying threats to warfighters across the physical and cyber domains. Completed the development of optimizing exploitation across sensors to enhance multi-INT fusion. ***FY 2013 Plans:*** Complete the development, test, and evaluation of real-time, tactical information exploitation software using laboratory tools and operational data. Continue development of a wide variety of exploitation methods to enhance signals situational awareness. Continue in-house and university research in advanced exploitation techniques that maximize the Air Force's ability to gather, process, and display information from multi-INT sources identifying threats to warfighters across the physical and cyber domains. ***FY 2014 Plans:*** Continue development of a wide variety of exploitation methods to enhance signals situational awareness. Continue in-house and university research in advanced exploitation techniques that maximize the Air Force's ability to gather, process, fuse, and display information from multi-intelligence sources identifying threats to warfighters across the physical and cyber domains.			
Title: Next Generation Command Technologies ***Description:*** Develop modeling and simulation technologies for the next generation of planning, assessment, and execution environments. ***FY 2012 Accomplishments:*** Developed tools for the analyst to identify the optimum set of leverage points to meet commander's objectives. Identified the degree to which the adversary can achieve hypothesized COAs based on predicted goals. Developed an integrated set of possible combinations of adversary COAs and adversarial intentions based on the adversary's abilities and capabilities to perform activities associated with various domains. ***FY 2013 Plans:*** Complete development of tools for the analyst to identify the optimum set of leverage points to meet commander's objectives. Complete the identification of degree to which the adversary can achieve hypothesized COAs based on predicted goals. Complete development of an integrated set of possible combinations of adversary COAs and adversarial intentions based on the adversary's abilities and capabilities to perform activities associated with various domains. ***FY 2014 Plans:*** Initiate research into advanced analytical capabilities that integrate kinetic and non-kinetic options with world knowledge to determine the effects those options will have on the environment, adversary and the general populace. Increase targeting capabilities to include the full range of options available to increase the depth and breadth of the analysis and reduce the overall time to perform analyses and generate targeting options.	3.007	0.949	3.142
Accomplishments/Planned Programs Subtotals	25.457	20.711	20.604

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 625318: *Operational Awareness Tech*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 62OMMS: *Research Site Support*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
62OMMS: *Research Site Support*	-	0.000	0.000	18.449	-	18.449	18.748	19.127	19.575	19.896	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

The Air Force Research Laboratory Information Directorate leads the discovery, development and implementation of information science and technology to drive transformation within the Air Force and across the DoD. The focus of the work is to provide the warfighter with the required technology-based capabilities to defend the Nation by unleashing the power of innovative information science and technology to anticipate, find, fix, track, target, engage, and assess anything, anytime, anywhere. Since the site is a single-purpose location not located on a military installation, the Information Directorate has unique requirements for supporting its S&T mission. As the host unit, the directorate is responsible to provide the Rome Research Site infrastructure at Rome, NY and provide for the continued operations of all Rome Research Site properties, buildings, and services necessary for the research mission. Operations include: logistics and communication services, utilities, maintenance of facilities and structures, safety and security of the workforce and visiting researchers, and ensures compliance with the laws, regulations and directives that pertain to site operations. These services are host unit responsibilities and are necessary to provide a safe and effective environment for the Research Site's workforce and mission.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Rome Research Infrastructure	0.000	0.000	18.449
Description: Provide the necessary services and support including, but not limited to: fire inspections, refuse collection, water, electricity, steam, heat, custodial, and grounds maintenance services to the Research Site. Provide the necessary support for the maintenance and repair of Research Site facilities (buildings and other structures), vehicle and equipment lease and security/ safety inspections and services as necessary for compliance and safety/security of personnel and research assets. Provide the Research Site with long haul communications (NETWORX (CONUS)), trunk connectivity and wireless communications.			
FY 2012 Accomplishments: N/A			
FY 2013 Plans: N/A			
FY 2014 Plans: Provide civilian payroll and non-pay costs for installation operations in support of the Rome Research Site property and all on-site personnel. Provide facilities, facility operations, facility sustainment, support equipment, contracts and associated costs			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602788F: *Dominant Information Sciences and Methods*	PROJECT 62OMMS: *Research Site Support*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
to plan, manage and execute the following functions: fire prevention, disaster preparedness, plant operation and purchase of commodity, refuse collection, pavement clearance of snow and ice, grounds maintenance including landscaping, real property special inspections, pest control and custodial services. Provide Real Property Management & Engineering Services, including: (1) Facility Management and Administration and (2) Installation Engineering Services. Facility Management includes public works management costs, contract management, material procurement, facility data management, furnishings management costs, and real estate management. Installation Engineering Services includes annual inspection of facilities, master planning, overhead of planning and design, overhead of construction management, and non-Sustainment and Restoration Modernization (SRM) service calls. Provide basic installation communication services, including long haul trunk and telecommunications services. Provide site vehicle lease under GSA for logistics, security, and mission support.			
Accomplishments/Planned Programs Subtotals	0.000	0.000	18.449

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*					R-1 ITEM NOMENCLATURE PE 0602890F: *High Energy Laser Research*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	52.186	38.557	40.217	-	40.217	41.575	42.316	42.636	43.405	Continuing	Continuing
625096: *High Energy Laser Research*	-	52.186	38.557	40.217	-	40.217	41.575	42.316	42.636	43.405	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Note: In FY 2013, reductions due to higher Department of Defense priorities.

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). This program is part of an overall DoD HEL Science and Technology (S&T) program. 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 defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles and the ultra-precision negation of targets in urban environments with minimal collateral damage. Efforts funded under this program are generally 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 electrically powered lasers, laser beam control, and laser lethality mechanisms. Efforts in this program have been coordinated through the DoD S&T Executive Committee process to harmonize efforts and eliminate duplication. 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 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602890F: *High Energy Laser Research*	

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	53.791	38.557	40.177	-	40.177
Current President's Budget	52.186	38.557	40.217	-	40.217
Total Adjustments	-1.605	0.000	0.040	-	0.040
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-1.605	0.000			
• Other Adjustments	0.000	0.000	0.040	-	0.040

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Robust Electric Lasar Initiative	12.751	11.847	11.750
Description: Advance solid-state laser development. ***FY 2012 Accomplishments:*** Continued a joint high power electric laser product improvement program, as part of the Robust Electric Laser Initiative (RELI) effort, with Army and Air Force. Monitored and evaluated progress toward a 25 kilowatt (kW) laser design. ***FY 2013 Plans:*** Continue a joint high power electric laser product improvement program, as part of the RELI effort. Select efforts to build a 25kW laser source. Prepare for government-sponsored measurements to validate performance. ***FY 2014 Plans:*** Continue a joint high power electric laser product improvement program, as part of the RELI effort. Monitor technical progress toward multiple 25kW laser sources. Finalize preparations and equipment for government-sponsored measurements to validate performance.			
Title: Solid State Lasar Technologies	9.386	6.290	6.377
Description: Mature technologies that will provide system level performance commensurate with fieldable solid-state laser devices. ***FY 2012 Accomplishments:***			

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602890F: *High Energy Laser Research*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Developed high reliability/cost efficient diode pump sources. Scaled alternate laser wavelengths to militarily relevant power levels. Developed high power capable fiber technologies. Conducted an industry proposal call for FY 2012 and awarded nine new contracts. ***FY 2013 Plans:*** Develop highly efficient, compact, modular electric laser systems. Advance technology for laser gain material, improved heat extraction, and novel fiber architectures. Conduct a Service and Agency proposal call for FY 2013. ***FY 2014 Plans:*** Develop highly efficient, compact, modular electric laser systems. Develop high reliability/cost efficient diode pump sources. Scale alternate laser wavelengths to militarily relevant power levels. Develop high power delivery fiber technologies. Conduct an industry proposal call for FY 2014.			
Title: Free Electron Laser Technologies ***Description:*** Conduct system-level technology development to facilitate scaling of free electron lasers (FELs) to weapons-class power levels. ***FY 2012 Accomplishments:*** Demonstrated technologies for a 100kW lab demonstration, with emphasis on technologies that can support 1 megawatt (MW) future FEL performance. Conducted an industry proposal call for FY 2012 and awarded three new contracts. ***FY 2013 Plans:*** Complete technologies for 100kW lab demonstration. Effort transitions to the Navy, PE 0602114N. ***FY 2014 Plans:*** N/A	3.850	0.580	0.000
Title: Advanced HEL Technologies ***Description:*** Investigate new technologies that have revolutionary potential for HEL applications. ***FY 2012 Accomplishments:*** Explored novel laser technologies to improve efficiency and decrease mass/volume. Evaluated new materials for high energy laser applications. Completed military assessment of applications for short pulse laser technology. Continued to scale electrically pumped alkali lasers to kW-class power levels. Conducted an industry proposal call for FY 2012 and awarded 12 new contracts. ***FY 2013 Plans:***	9.242	5.920	7.520

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602890F: *High Energy Laser Research*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Explore novel laser technologies to improve efficiency and decrease mass/volume. Evaluate new materials for high energy laser applications, to include optics in a high-gain vacuum. Demonstrate applications for short pulse laser technology. Continue to scale electrically pumped alkali lasers to increased power levels. Conduct a Service and Agency proposal call for FY 2013. ***FY 2014 Plans:*** Explore novel laser technologies to improve efficiency and decrease mass/volume. Evaluate new materials for high energy laser applications, to include optics in a high-gain vacuum. Demonstrate applications for short pulse laser technology. Continue to scale electrically pumped alkali lasers to increased power levels. Conduct an industry proposal call for FY 2014.			
Title: Laser Beam Control Technologies ***Description:*** Develop technology to support high performance beam control systems and integrated demonstrations. ***FY 2012 Accomplishments:*** Explored beam control technology options for laser weapon use on multiple platforms (aircraft, ground vehicles and shipboard systems) in stressing environments. Conducted an industry proposal call for FY 2012 and awarded 11 new contracts. ***FY 2013 Plans:*** Explore beam control technology options for laser weapon use on multiple platforms (aircraft, ground vehicles and shipboard systems) in stressing environments. Conduct a Service and Agency proposal call for FY 2013. ***FY 2014 Plans:*** Explore beam control technology options for laser weapon use on multiple platforms (aircraft, ground vehicles and shipboard systems) in stressing environments. Conduct an industry proposal call for FY 2014.	9.517	7.240	7.660
Title: Lethality Research ***Description:*** Conduct laser vulnerability experiments on materials, components, and targets. Develop a lethality database, and integrate into a systems-level architecture plan and lethality models. ***FY 2012 Accomplishments:*** Integrated lethality data into campaign-level HEL system models. Continued laser vulnerability experiments on materials, components, and targets. Completed the Counter-Unmanned Aerial System vulnerability module and incorporated into modeling tools. ***FY 2013 Plans:***	4.460	3.560	3.590

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602890F: *High Energy Laser Research*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
In close coordination with existing HEL models, integrate lethality data into campaign-level HEL system models. Conduct laser vulnerability experiments on materials, components, and targets. ***FY 2014 Plans:*** In close coordination with existing HEL models, integrate additional lethality data into campaign-level HEL system models. Conduct laser vulnerability experiments on materials, components, and targets.			
Title: HEL Modeling ***Description:*** Maintain and evaluate high-fidelity engineering models for HEL system scenario evaluation and incorporation into the HEL toolkit. Provide for HEL system modeling for mission-level war gaming activities. ***FY 2012 Accomplishments:*** Provided maintenance, verification, validation, and accreditation for updated system level HEL models. Conducted mission-level HEL engagement scenarios and wargame HEL concepts. Incorporated predictive avoidance modeling into existing HEL toolkit. ***FY 2013 Plans:*** Provide maintenance, verification, validation, and accreditation for updated system level HEL models. Conduct mission-level HEL engagement scenarios and wargame HEL concepts. Incorporate enhanced predictive avoidance modeling into existing HEL toolkit. ***FY 2014 Plans:*** Provide maintenance, verification, validation, and accreditation for updated system level HEL models. Conduct mission-level HEL engagement scenarios and wargame HEL concepts. Incorporate additional predictive avoidance modeling into existing HEL toolkit .	2.980	3.120	3.320
Accomplishments/Planned Programs Subtotals	52.186	38.557	40.217

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A

F. 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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*					R-1 ITEM NOMENCLATURE PE 0603112F: *Advanced Materials for Weapon Systems*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	60.626	47.890	39.572	-	39.572	35.229	33.649	38.072	38.184	Continuing	Continuing
632100: *Laser Hardened Materials*	-	22.209	11.564	20.450	-	20.450	19.531	16.170	17.735	17.480	Continuing	Continuing
633153: *Non-Destructive Inspection Development*	-	3.788	8.413	6.766	-	6.766	4.831	4.870	4.962	5.052	Continuing	Continuing
633946: *Materials Transition*	-	30.980	27.020	12.356	-	12.356	10.867	12.609	15.375	15.652	Continuing	Continuing
634918: *Deployed Air Base Demonstrations*	-	3.649	0.893	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program develops and demonstrates materials technology for transition into Air Force systems. The program has four projects which develop: (1) hardened materials technologies for the protection of aircrews and sensors; (2) non-destructive inspection and evaluation technologies; (3) transition data on structural and non-structural materials for aerospace applications; and (4) airbase operations technologies including deployable base infrastructure, force protection, and fire fighting capabilities. Efforts in the program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	60.719	47.890	29.672	-	29.672
Current President's Budget	60.626	47.890	39.572	-	39.572
Total Adjustments	-0.093	0.000	9.900	-	9.900
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	0.750	0.000			
• SBIR/STTR Transfer	-0.843	0.000			
• Other Adjustments	0.000	0.000	9.900	-	9.900

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603112F: *Advanced Materials for Weapon Systems*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2012	FY 2013
Project: 633946: *Materials Transition*		
Congressional Add: *Silicon Carbide Composites Research*	12.500	0.000
Congressional Add: *Advanced Materials Research*	8.500	0.000
Congressional Add Subtotals for Project: 633946	21.000	0.000
Congressional Add Totals for all Projects	21.000	0.000

Change Summary Explanation

Increase in FY14 is due to increased emphasis on laser protection for aircrew and aerospace systems and on sustainment materials and process technologies to decrease lifecycle costs of Air Force systems.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603112F: *Advanced Materials for Weapon Systems*	PROJECT 632100: *Laser Hardened Materials*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
632100: *Laser Hardened Materials*	-	22.209	11.564	20.450	-	20.450	19.531	16.170	17.735	17.480	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 sensors and systems to ensure safety, survivability, and operability in threat environments.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Aerospace Systems Protection	18.122	5.996	10.800

Description: Develop and demonstrate materials technologies that enhance hardening for sensors, avionics, and components to increase survivability and mission effectiveness of aerospace systems.

FY 2012 Accomplishments:

Continued to evaluate and prioritize advanced optical coatings and optical power limiter technologies as protection against laser and directed energy threats aimed at sensors and avionics. Transitioned most mature coatings and optical limiter technologies for next generation targeting platforms. Initiated demonstrations of promising coating technologies into next generation of persistent surveillance sensor designs as well as demonstrated strategies to mitigate directed energy damage for Visible/Near Infrared (Vis/NIR) detectors and Short Wave Infrared (SWIR) detectors that are critical for Intelligence, Surveillance, and Reconnaissance (ISR) sensors. Continued testing of damage limiting semiconductor materials in test bed configuration to determine viability for protection of tactical and strategic space sensors and for SWIR systems. Assessed vulnerability of current seekers/munitions against emerging countermeasure threats.

FY 2013 Plans:

Continue demonstrations of viable coating and hardened focal planes for future persistent surveillance sensor designs as well as continue demonstrating strategies to mitigate directed energy damage for Vis/NIR, SWIR, and Mid Wave Infrared (MWIR) detectors critical to ISR sensors. Demonstrate damage-limiting semiconductor materials in a test bed configuration representing protection of both Vis/NIR and SWIR ISR sensors. Employ computation materials science to model materials characteristics to increase accuracy and shorten design cycle time of coatings and dyes for use in sensor hardening.

FY 2014 Plans:

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603112F: *Advanced Materials for Weapon Systems*	PROJECT 632100: *Laser Hardened Materials*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Ensure process repeatability and perform demonstrations of protection technologies for future ISR sensor designs as well as continue demonstrating strategies to mitigate directed energy damage for Vis/NIR, SWIR, and MWIR detectors. Assess impacts to image quality performance due to hardening insertion of damage-limiting semiconductor materials in a test bed configuration. Continue to employ computation materials science to model materials characteristics to increase accuracy and shorten design cycle time of coatings for use in sensor hardening. Initiate air systems airframe and anti-access munitions hardening assessment.			
Title: Aircrew Protection ***Description:*** Develop and demonstrate materials technologies that enhance protection for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in a threat environment. ***FY 2012 Accomplishments:*** Developed and demonstrated personnel protection technologies, including tailored rugate coatings and liquid crystal materials technologies specific for visor applications against visible and SWIR directed energy laser threats. Also investigated emerging limiter technologies and next generation dye concepts for the personnel protection across the visible and SWIR. Continued to evaluate performance and initiate process development of optical coatings within visor applications. ***FY 2013 Plans:*** Continue development and demonstration of personnel protection technologies for daytime operation across the visible/NIR and SWIR spectral bands. Fabricate and demonstrate performance of agile optical coatings and dyes for use in daytime visor configurations. Characterize eye protection technologies using computational materials science tools. Insure process repeatability and perform demonstrations of personnel protection technologies in realistic operation environments. ***FY 2014 Plans:*** Continue development and demonstration of personnel protection technologies. Transition agile optical coatings and dyes for use in night-time applications. Characterize eye protection technologies using computational materials science tools. Continue to improve process repeatability and perform demonstrations of personnel protection technologies in realistic operation environments.	4.087	5.568	9.650
Accomplishments/Planned Programs Subtotals	22.209	11.564	20.450

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603112F: *Advanced Materials for Weapon Systems*	PROJECT 632100: *Laser Hardened Materials*

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603112F: *Advanced Materials for Weapon Systems*	PROJECT 633153: *Non-Destructive Inspection Development*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
633153: *Non-Destructive Inspection Development*	-	3.788	8.413	6.766	-	6.766	4.831	4.870	4.962	5.052	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Advanced Engine Inspection Technologies	1.023	1.772	1.300
Description: Develop and demonstrate advanced technologies to improve capabilities to inspect for cracks and other damage to extend the total safe life of turbine engines. ***FY 2012 Accomplishments:*** Investigated NDI/E approaches to measure material properties to extend the life and increase durability of fracture-critical gas turbine engine components. ***FY 2013 Plans:*** Develop NDI/E approaches to nondestructively measure material properties, detect and characterize materials and damage state for the purpose of extending the life and increasing durability of fracture critical gas turbine engine components. ***FY 2014 Plans:*** Continue development of NDI/E approaches to nondestructively measure material properties, detect and characterize materials and damage state for the purpose of extending the life and increasing durability of fracture critical gas turbine engine components.			
Title: Low-Observable Inspection Technologies	0.421	0.541	0.466
Description: Develop and demonstrate advanced inspection technologies supporting low-observable (LO) systems to enhance affordability and ensure full performance and survivability. ***FY 2012 Accomplishments:***			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603112F: *Advanced Materials for Weapon Systems*	PROJECT 633153: *Non-Destructive Inspection Development*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Advanced inspection methods and sensor technology for signature and material integrity of next generation LO material systems. ***FY 2013 Plans:*** Develop and demonstrate inspection methods and sensor technology for signature and material integrity of existing and next generation LO material systems. Develop, demonstrate, and validate inspection methods to identify damage and register positions that enable/ensure signature assessment. ***FY 2014 Plans:*** Continue to develop and demonstrate inspection methods and sensor technology for signature and material integrity of existing and next generation LO material systems. Continue to develop, demonstrate, and validate inspection methods to identify damage and register positions that enable/ensure signature assessment.			
Title: Advanced System Monitoring Technologies ***Description:*** Develop and demonstrate advanced systems status monitoring technologies to provide on-board and embedded sensing to gain continuous awareness of the state of key subsystems. ***FY 2012 Accomplishments:*** Continued to transition smart sensor technologies for wiring health analysis. Continued to transition field and depot-level inspection tools for assessing the structural health of airframes. ***FY 2013 Plans:*** Continue to develop and transition augmented field and depot-level inspection technologies for assessing the structural integrity of airframes. Integrate computational materials science tools with life prediction methods to increase accuracy of life prediction. Demonstrate and transition advanced turbine engine process/status monitoring technologies to enable adaptive functions. ***FY 2014 Plans:*** Transition augmented field and depot-level inspection technologies for assessing the structural integrity of airframes. Integrate computational materials science tools with life prediction methods to increase accuracy of life prediction. Continue to demonstrate and transition advanced turbine engine process/status monitoring technologies to enable adaptive functions.	2.344	6.100	5.000
Accomplishments/Planned Programs Subtotals	3.788	8.413	6.766

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603112F: *Advanced Materials for Weapon Systems*	PROJECT 633153: *Non-Destructive Inspection 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.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603112F: *Advanced Materials for Weapon Systems*	PROJECT 633946: *Materials Transition*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
633946: *Materials Transition*	-	30.980	27.020	12.356	-	12.356	10.867	12.609	15.375	15.652	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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. This design and scale-up data improves the overall affordability of promising materials and processing technologies, providing needed initial incentives for their industrial development.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Air Vehicle Materials Technologies	4.934	6.320	7.721
Description: Develop and demonstrate materials and processes technologies for air vehicle and subsystems to enhance lift, propulsion, LO performance, power generation management, and affordability of air vehicles. ***FY 2012 Accomplishments:*** Demonstrated high rate production-capable processes for producing large area, high quality diamond windows for airborne high power microwave directed energy weapons. Developed materials enabling critical components for next-generation airborne high energy lasers that are solid state, electrically-powered, and significantly higher efficiency. Advanced validation of processing methods and lifing tools for graded microstructure turbine engine disk concepts. Advanced validation of processing methods and lifing methodologies for advanced high temperature silicon carbide (SiC)/SiC-based composites. Developed and validated next generation NDE/I sensor systems for advanced LO material systems. ***FY 2013 Plans:*** Continue to advance validation of processing methods and lifing tools for graded microstructure turbine engine disk concepts. Transition validation of next generation NDE/I sensor systems for advanced LO material systems. Develop advanced materials and processes for mature materials technologies to enhance mission effectiveness, air vehicle performance, and efficiency. ***FY 2014 Plans:*** Continue to advance validation of processing methods and lifing tools for ceramic matrix composites and graded microstructure turbine engine disk concepts. Continue to transition validated next generation NDE/I sensor systems for advanced LO material			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603112F: *Advanced Materials for Weapon Systems*	PROJECT 633946: *Materials Transition*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
systems. Continue to develop advanced materials and processes for mature materials technologies to enhance mission effectiveness, air vehicle performance, and efficiency.			
Title: Lifecycle and Sustainment Technologies ***Description:*** Develop and demonstrate materials and process technologies to enhance sustainability and decrease lifecycle costs of Air Force systems. ***FY 2012 Accomplishments:*** Demonstrated and transitioned innovative technologies for bare base utilities. ***FY 2013 Plans:*** Work completed in FY12. ***FY 2014 Plans:*** N/A	0.750	0.000	0.000
Title: High Temperature Material Technologies ***Description:*** Develop and demonstrate affordable, novel high temperature materials/structures and thermal management concepts to enable future defense capabilities for prompt global strike concepts. ***FY 2012 Accomplishments:*** Advanced multi-material structure to optimally address operational temperature zones for hot structure and thermal protection systems from advanced ceramics, ceramic matrix composites, hybrids, advanced metals, and intermetallics. ***FY 2013 Plans:*** Continue to advance multimaterial structure to optimally address operational temperature zones for hot structure and thermal protection systems. ***FY 2014 Plans:*** Develop and demonstrate multimaterial structures to optimally address operational temperature zones for hot structure and expendable thermal protection systems made out of advanced ceramics, ceramic matrix composites, hybrids, advanced metals, and intermetallics.	4.296	1.000	2.635
Title: Adapative Turbine Engine Technologies ***Description:*** Develop and demonstrate material and process technologies to increase power and efficiency for adaptive turbine engine propulsion and subsystem integration.	0.000	19.700	2.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603112F: *Advanced Materials for Weapon Systems*	PROJECT 633946: *Materials Transition*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: N/A ***FY 2013 Plans:*** Transition production processes and materials to enable an adaptive turbine engine prototype. Perform critical evaluations of technology in the operating environment. ***FY 2014 Plans:*** Complete materials and production processes assessments for an adaptive turbine engine prototype.			
Accomplishments/Planned Programs Subtotals	9.980	27.020	12.356

	FY 2012	FY 2013
Congressional Add: Silicon Carbide Composites Research ***FY 2012 Accomplishments:*** Conducted Congressionally-directed effort. ***FY 2013 Plans:*** N/A	12.500	0.000
Congressional Add: Advanced Materials Research ***FY 2012 Accomplishments:*** Conducted Congressionally-directed effort. ***FY 2013 Plans:*** N/A	8.500	0.000
Congressional Adds Subtotals	21.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603112F: *Advanced Materials for Weapon Systems*	PROJECT 634918: *Deployed Air Base Demonstrations*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
634918: *Deployed Air Base Demonstrations*	-	3.649	0.893	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced, rapidly deployable airbase technologies that enable agile combat support by reducing airbase manpower requirements, reducing airbase setup times and improving the protection and survivability of deployed Air Force Expeditionary (AFE) warfighters. Affordable, efficient technologies are developed and demonstrated to provide deployable infrastructure, weapon system support, blast and munition force protection and firefighting capability for deployed AEF operations.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Deployable Airbase Infrastructure	1.591	0.000	0.000
Description: Demonstrate and transition deployable infrastructure airbase technologies, to reduce airlift and manpower requirements, setup time, and sustainment costs in support of AEF operations. ***FY 2012 Accomplishments:*** Characterized, demonstrated, and fabricated airbase alternative energy generation, power grid conditioning, and distribution methods. Characterized and developed best practices for aircraft operating surface evaluation and repair technologies. Characterized, fabricated, and demonstrated aircraft operating surface high operating temperature materials and technologies. ***FY 2013 Plans:*** Work completed in FY12. Future work in this area transitioned to the Air Force Civil Engineering Center. ***FY 2014 Plans:*** N/A			
Title: Deployable Airbase Force Protection	2.058	0.893	0.000
Description: Demonstrate and transition technologies to provide force protection and fire fighting capability for deployed AEF operations. ***FY 2012 Accomplishments:***			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603112F: *Advanced Materials for Weapon Systems*	PROJECT 634918: *Deployed Air Base Demonstrations*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Characterized and maintained competency for fabrication and demonstration of technologies for airbase structural protection against blast and fragmentation. Characterized and developed technologies for airbase fire fighting and composite materials combustion. ***FY 2013 Plans:*** Transitioned work to the Air Force Civil Engineering Center. ***FY 2014 Plans:*** Work completed in FY13. Future work in this area transitioned to the Air Force Civil Engineering Center.			
Accomplishments/Planned Programs Subtotals	3.649	0.893	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*					R-1 ITEM NOMENCLATURE PE 0603199F: *Sustainment Science and Technology (S&T)*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	5.618	6.565	12.800	-	12.800	15.800	18.500	20.800	23.000	Continuing	Continuing
635351: *Technology Sustainment*	-	5.618	6.565	12.800	-	12.800	15.800	18.500	20.800	23.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops and demonstrates sustainment technologies such as: materials, corrosion, maintenance/repair techniques, state awareness/non-destructive inspection, health management, life prediction, and logistics for transition into fielded and future Air Force systems to reduce life cycle sustainment costs and increase readiness. Technologies matured and demonstrated impact affordability and availability of fielded aerospace weapon systems by reducing sustainment costs, extending service life, and maintaining mission readiness and capability. This project develops and demonstrates maintenance, life cycle management, and system/fleet decision making technologies that can be implemented to address operational sustainment issues and could influence future system sustainability decisions via risk reduction to support inclusion into new systems. Studies are conducted to analyze processes and methodologies for application of technologies to address sustainment issues across the force, identifying cross cutting applications for fielded systems, and opportunities for building in sustainability into future applications. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops, demonstrates and transitions technologies for sustaining aerospace systems that have military utility and address warfighter needs.

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	5.780	6.565	9.839	-	9.839
Current President's Budget	5.618	6.565	12.800	-	12.800
Total Adjustments	-0.162	0.000	2.961	-	2.961
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-0.162	0.000			
• Other Adjustments	0.000	0.000	2.961	-	2.961

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603199F: *Sustainment Science and Technology (S&T)*

Change Summary Explanation

Increase in FY14 is due to increased DoD emphasis on sustainment.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: System Health Management/Assessment Technologies	2.788	2.023	4.425
Description: Develop, demonstrate, and transition state awareness/system health management technologies. Conduct studies and analyses to design sustainability into future applications. ***FY 2012 Accomplishments:*** Validated model to verify F-22 wing lug residual stress treatments which enable a 4X-6X life extension. Developed, demonstrated, and transitioned color changing tape and passive RFID technologies for KC-135 fuel bladder leak detection. Developed and transitioned an ultrasonic inspection NDI procedure to detect cracks on KC-135 wing terminal fitting flange, saving numerous man hours on wing inspections. Demonstrated and transitioned capability to virtually re-inspect fielded engine rotors to identify parts incorrectly passed during overhaul, avoiding 13 engine teardowns and maintaining six aircraft in service. ***FY 2013 Plans:*** Continue verification of state-of-the-art algorithms and techniques to assess health and real-time awareness for weapon system components. Continue to develop life prediction models for extending component life, and to demonstrate and incorporate health assessment technologies into sustainment operations. Complete validation of eddy current non-destructive inspection (NDI) techniques for multiple aircraft for field and depot level inspections, which will improve crack detection in multiple layers of material and beneath fasteners. Initiate efforts to monitor/assess health of airframe/engine, wiring insulation and oil. ***FY 2014 Plans:*** Continue efforts to demonstrate and validate algorithms and techniques for system assessment and health management. Initiate quantification of life extension prediction of A-10 and T-38 aircraft cold worked holes, development of active fuel bladder leak detection capability, and health assessment capability development for fielded systems and components. Continue development and demonstration of diagnostic technology to monitor/assess health of airframe/engine, wiring insulation, and oil.			
Title: Prevention/Enhanced Maintainability Technologies	0.886	2.527	5.340
Description: Develop, demonstrate, and transition technologies to improve component design, maintenance, replacement, and concepts for performance improvement and reduced maintenance burden. ***FY 2012 Accomplishments:*** Completed demonstration of a new Aluminum alloy and innovative process to replace end fittings for C-5 floor bulkhead, resulting in 80% reduction in fabrication time, and 60% increase in service life. Installed on aircraft Nov 2011. Completed			

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603199F: *Sustainment Science and Technology (S&T)*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
commercialization of powered gap filler removal tools for F-22 and B-2, demonstrated 50% man-hour savings, reducing field/depot maintenance costs and worker injuries. ***FY 2013 Plans:*** Continue efforts to develop life enhancement/replacement/repair technologies and demonstrate high reliability solutions. Initiate efforts to develop honeycomb replacement alternatives for the C-5 and a two-fold increase in Mean Time Between Failure (MTBF) for the MQ-1 Predator sensor cryo-coolers. Complete: Residual stress surface treatment approach, enabling a three-fold extension of the A-10 aircraft wing splice life; Design, validate and manufacture aluminum hybrid alternative for A-10 longeron strap replacement to support airframe service life extension; and demonstrate engine component technologies to enable conversion of MQ-1 Predator engines from AVGAS to JP-8, increasing safety, saving cost of fuel, and increasing engine durability by 10%. ***FY 2014 Plans:*** Continue efforts to demonstrate high reliability repair and maintenance technologies to increase service time between maintenance actions. Continue maturation of airframe/engine/subsystem technologies including replacement for honeycomb structures, demonstration of a two-fold increase in MQ-1 Predator sensor cryocoolers, and validation of erosion coating test protocol for improved component durability, reliability, and safety to increase time between maintenance actions and reduce maintenance cost drivers. Initiate demonstration of a solid state amplifier replacement for unsupportable vacuum tubes used on the B-1 aircraft's ALQ-161, defensive avionics system.			
Title: Management/Improved Reliability Technologies ***Description:*** Develop, demonstrate, and transition technologies to improve existing and new components, fleet management/ decision-making tools, and supply chain/sustainment infrastructure to decrease downtime, costs, and increase reliability. ***FY 2012 Accomplishments:*** Designed, developed and demonstrated new digital fuel quantity indicator technology for C-130 that increases life and provides a more viable and reliable fuel reading. Demonstrated operational benefit of engine health monitoring system fault resolution tool to ID faulty/broken components to resolve issues on fielded jets. Initiated F-15C/D Stick-to-Stress Real-Time Simulator Tool to provide for more accurate & rapid analysis tool to manage unexpected new cracking locations. ***FY 2013 Plans:*** Continue to evaluate technological means to adjust system management and operational sustainment requirements. Initiate effort to demonstrate probabilistic approach to engine component life management to eliminate some inspection requirements or increase inspection intervals, reducing engine overhaul costs. Initiate effort to reduce Fuel System Icing Inhibitor levels in JP-8,	1.944	2.015	3.035

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603199F: *Sustainment Science and Technology (S&T)*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
reducing costs of additive and maintenance due to fuel tank coat peeling in the B-52 aircraft. Complete validated F-15C/D Stick-to-Stress Real-Time Simulator Tool to provide for more accurate & rapid analysis tool to manage unexpected new cracking locations. ***FY 2014 Plans:*** Continue efforts to develop system fleet management decision-making tools, repair data base technologies and techniques, and supply chain/infrastructure approaches to reduce sustainment costs. Continue efforts to: develop and demonstrate a probabilistic approach to determine fatigue life limits of engine components to revise inspection and replacement intervals to reduce sustainment costs; install a single depot level software architecture for engine part actuarial processes; develop and validate a corrosion severity/time model for hot spots on the C-5 to improve anticipation and management of corrosion damage. Continue probabilistic approach to component life management and effort to reduce icing inhibitor levels in JP-8.			
Accomplishments/Planned Programs Subtotals	5.618	6.565	12.800

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

Not Applicable.

F. 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 2014 Air Force											DATE: April 2013	
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)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	119.227	37.657	30.579	-	30.579	29.808	29.496	33.641	33.433	Continuing	Continuing
63665A: *Advanced Aerospace Sensors Technology*	-	34.705	16.269	16.649	-	16.649	12.809	14.900	14.609	15.245	Continuing	Continuing
6369DF: *Target Attack and Recognition Technology*	-	84.522	21.388	13.930	-	13.930	16.999	14.596	19.032	18.188	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

Divided into two 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 (RF)and electro-optical (EO)sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets obscured by natural or man-made means. 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 has been coordinated through the the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. 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.

B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	121.666	37.657	31.366	-	31.366
Current President's Budget	119.227	37.657	30.579	-	30.579
Total Adjustments	-2.439	0.000	-0.787	-	-0.787
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	-1.573	0.000			
• SBIR/STTR Transfer	-0.866	0.000			
• Other Adjustments	0.000	0.000	-0.787	-	-0.787

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
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*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2012	FY 2013
Project: 63665A: *Advanced Aerospace Sensors Technology*		
Congressional Add: *Program Increase*	10.000	-
Congressional Add Subtotals for Project: 63665A	10.000	0.000
Project: 6369DF: *Target Attack and Recognition Technology*		
Congressional Add: *Blue Devil 1*	58.600	-
Congressional Add Subtotals for Project: 6369DF	58.600	0.000
Congressional Add Totals for all Projects	68.600	0.000

Change Summary Explanation

Reprogrammed for specific projects in accordance with Section 219 of the Duncan Hunter National Defense Authorization Act for Fiscal Year (FY) 2009, as amended by Section 2801 of the National Defense Authorization Act for FY 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603203F: *Advanced Aerospace Sensors*	PROJECT 63665A: *Advanced Aerospace Sensors Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
63665A: *Advanced Aerospace Sensors Technology*	-	34.705	16.269	16.649	-	16.649	12.809	14.900	14.609	15.245	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops and demonstrates aerospace sensor and processing technologies for intelligence, surveillance, reconnaissance (ISR), 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Integrated Navigation Technologies	5.963	1.621	4.500

Description: Develop and demonstrate technologies to provide precision position and timing information to enable distributed, layered sensing on air and space vehicles in Global Positioning System (GPS) degraded/denied environments. Develop technologies to maximize positional accuracy, timing accuracy, and exploitation techniques to improve offensive and defensive combat capabilities. Simulate, develop, and demonstrate integrated navigation warfare technologies, to establish and maintain a military advantage in satellite-based navigation.

FY 2012 Accomplishments:

Developed strategies to optimize reference technologies for distributed sensing missions. Explored alternatives when GPS is degraded or denied. Reduced size, weight, and power of inertial components. Enhanced precision of GPS and non-GPS reference technologies. Developed reference optimization components necessary to support bi-static and multi-static radar technologies. Evaluated progress and determined next spiral requirements.

FY 2013 Plans:

Continue to develop strategies to optimize reference technologies for distributed sensing missions. Maintain/enhance performance while reducing size, weight, and power. Continue development of reference optimization components necessary to support bi-static and multi-static radar technologies.

FY 2014 Plans:

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603203F: *Advanced Aerospace Sensors*	PROJECT 63665A: *Advanced Aerospace Sensors Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Develop technologies to preserve position, navigation, and timing (PNT) avilability, including augmentation technologies for GPS in the event of outage, and advanced technologies that do not rely on GPS. Explore integration of GPS with precise inertial measurement units (IMUs) and augmentation using geo-referenced imagery. Collaborate with Space Vehicles Directorate to develop advanced, low-drift IMUs involving novel measurement techniques.			
Title: Persistent Sensing in Contested Environment Technologies ***Description:*** Develop active RF sensor solutions to use against difficult-to-detect targets in challenging environments, and advanced RF architectures for open and reconfigurable systems. Enable persistent ISR over wide areas, and detect advanced air and ground targets. ***FY 2012 Accomplishments:*** Initiated test and evaluation of dismount radar detection back end and algorithms in conjunction with the outdoor range. Initiated persistent multiple intelligence (multi-INT) sources layered sensing demonstration. Developed modular RF backend (demonstration of open systems architecture) for combined radar and signals intelligence (SIGINT) processing for eventual integration into the outdoor range. Provided systems engineering for development of integrated sensor for high altitude ISR. Initiated support and risk reduction efforts for a high altitude radar flight demonstration. ***FY 2013 Plans:*** Complete development of modular RF backend (demonstration of open systems architecture) for combined radar and SIGINT processing and integrate into the outdoor range. Continue development and testing of a wide area staring radar. ***FY 2014 Plans:*** Complete modular RF backend demonstration for combined radar and SIGINT. Continue research and development of a wide area staring radar, and begin development of staring rader RF testbed. Initiate research and development in next generation active RF sensing for contested spectrum environments, including investigation of the limits of active RF sensing with an emphasis on contested and denied environments.	14.337	8.844	4.000
Title: Passive RF Sensing Technologies ***Description:*** Develop advanced techniques and prototype passive RF sensors to intercept, collect, locate and track enemy RF sensor systems for intelligence, reconnaissance and surveillance of air and ground targets. ***FY 2012 Accomplishments:***	3.246	3.675	4.149

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603203F: *Advanced Aerospace Sensors*	PROJECT 63665A: *Advanced Aerospace Sensors Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Completed system engineering and performed initial flight test of multistatic radar using existing aperture and receiver components. Collected flight data for small RPA direction finding and geolocation system, processed data using multiple algorithms. Demonstrated advanced electromagnetic methods for detecting difficult targets. ***FY 2013 Plans:*** Complete flight test data collection of passive multistatic radar process data and develop algorithms for future multistatic radar systems. ***FY 2014 Plans:*** Initiate research for creating passive RF sensing testbed for use in indoor and outdoor range laboratories. Initiate advanced exploration and investigation of the limits of passive RF sensing with an emphasis on innovative passive techniques for operations in contested and denied environments. Develop advanced techniques for the exploitation of active RF emitters utilizing passive RF sensing techniques. Conduct research and development of passive RF sensors including phenomenology, modeling and simulation, algorithm development and experimentation.			
Title: Long Range Sensing Technologies ***Description:*** Develop radio frequency (RF) and electro-optical (EO) 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. ***FY 2012 Accomplishments:*** Performed concept validation and signature utility experiments for long-range synthetic aperture laser radar imaging. Conducted laboratory and field experiments for mitigating primary risk areas associated with synthetic aperture laser radar imaging from airborne platforms. Initiated development of master oscillator technology. ***FY 2013 Plans:*** Refine performance and signature models to validated requirements and concept of operations for long range synthetic aperture laser radar imaging. Continue laboratory and field experiments for mitigating primary risk areas associated with synthetic aperture laser radar imaging from airborne platforms. ***FY 2014 Plans:*** Initiate development of advanced active and passive electro-optical sensing technologies for surveillance and reconnaissance at standoff ranges in contested environments. Continue develop of long range temporal synthetic aperture ladar system. Demonstrate high power, high coherence transmitter and receiver array. Initiate ground and flight test plans for aircraft integration. Develop transceiver hardware for ground based imaging of satellite in geosyncronous orbit. Initiate test and	0.744	2.129	4.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603203F: *Advanced Aerospace Sensors*	PROJECT 63665A: *Advanced Aerospace Sensors Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
characterization of mercury-cadmium-teluride on silicone focal plane. Initiate design and prototyping of passive infrared imaging system for enhanced range infrared target recognition and full motion video.			
Title: Dynamic Target Technologies ***Description:*** Develop electro-optical sensing technologies for surveillance, tracking, and identification of dynamic targets in urban areas from manned and unmanned platforms. ***FY 2012 Accomplishments:*** Conducted concept demonstration experiments for exploiting infrared persistent surveillance imagery to detect, track, and characterize targets in urban areas. Performed utility assessment experiments to quantify system performance, analyzed human perception performance, and developed image processing techniques. Conducted proof-of-concept development of large format infrared camera technology for distributed airborne surveillance. ***FY 2013 Plans:*** Effort terminated due to higher DoD priorities. ***FY 2014 Plans:*** N/A	0.415	0.000	0.000
Accomplishments/Planned Programs Subtotals	24.705	16.269	16.649

	FY 2012	FY 2013
Congressional Add: Program Increase ***FY 2012 Accomplishments:*** Conducted Congressionally-directed effort for Program Increase.	10.000	-
Congressional Adds Subtotals	10.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603203F: *Advanced Aerospace Sensors*	PROJECT 63665A: *Advanced Aerospace Sensors 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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603203F: *Advanced Aerospace Sensors*	PROJECT 6369DF: *Target Attack and Recognition Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
6369DF: *Target Attack and Recognition Technology*	-	84.522	21.388	13.930	-	13.930	16.999	14.596	19.032	18.188	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Automatic Target Recognition	4.809	0.516	0.000
Description: Develop and demonstrate an automatic target recognition capability integrated with advanced geo-registration techniques and innovative change detection algorithms.			
FY 2012 Accomplishments: Conducted assessment and enhancement of technology supporting time-critical targeting systems for Planning & Direction, Collection, Processing & Exploitation, Analysis & Production, and Dissemination (PCPAD)Experimentation. Conducted spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Enhanced the Air Force automatic target recognition test and evaluation facility and datasets as required to support enhanced PCPAD capabilities.			
FY 2013 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603203F: *Advanced Aerospace Sensors*	PROJECT 6369DF: *Target Attack and Recognition Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Complete development of enhancements to automatic target recognition, automatic target cueing, geo-registration, and change detection technology to meet warfighter needs. Complete assessment and enhancement of technology supporting time-critical targeting systems in automatic target recognition. Complete development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Enhance the Air Force automatic target recognition test and evaluation facility and data sets as required to support enhanced time-critical targeting capabilities. Complete development and assessment of time-critical targeting and advanced target tracking technologies required to meet warfighter requirements. ***FY 2014 Plans:*** Effort moved to Thrust 4 in this Project to better align efforts.			
Title: Integrated Sensor Targeting Technologies ***Description:*** Develop an advanced suite of sensors with automatic target recognition, fusion, and target tracking, all working in concert to provide a high-confidence identification capability. ***FY 2012 Accomplishments:*** Identified candidate technologies to address deficiencies to improve aimpoint tracking, electro-optical automatic target recognition, synthetic aperture radar automatic target recognition, and the multi-sensor fusion algorithms. Predicted performance of the integrated technologies and system. Enhanced phenomenological modeling, target, and scenario databases and exploitation tools necessary to support technology development. Assessed maturity of applicable technology. ***FY 2013 Plans:*** Continue to identify candidate technologies to address deficiencies to improve electro-optical automatic target recognition, synthetic aperture radar automatic target recognition, and multi-sensor fusion algorithms. ***FY 2014 Plans:*** Continue identification of new candidate technologies to address deficiencies to improve electro-optical automatic target recognition, synthetic aperture radar automatic target recognition and the multi-sensor fusion algorithms for both PCPAD and combat identification applications in contested and denied environments. Enhance phenomenological modeling, target and scenario databases and exploitation tools necessary to address contested and denied environments. Continue development of PCPAD capabilities for non-contested environments.	6.247	3.042	2.700
Title: Air-to-Ground Identification Technologies ***Description:*** Develop an "identify friend, foe, or neutral" air-to-ground capability using cooperative and non-cooperative identification techniques.	0.988	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603203F: *Advanced Aerospace Sensors*	PROJECT 6369DF: *Target Attack and Recognition Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Developed physics-based signature exploitation, modeling methods, and signal processing for feature-based recognition and fusion and applied these methods to sensor design to enable performance-based sensing. Developed an integrated radar sensor signature exploitation and signal processing analysis capability for recognition applications including staring radar,combat identification (CID), space situational awareness (SSA), measurement and signatures intelligene (MASINT), and ISR applications. Developed efficient methods for collecting and processing radar sensor data for recognition. Developed methods to analyze salient features to aid in the prediction, analysis, and processing capability as a function of sensor design parameters for performance-driven sensing. Developed a loosely coupled capability for multi-sensor measurement, processing, modeling, and analysis methods to support target recognition database development efforts and MASINT applications. ***FY 2013 Plans:*** Effort terminated due to higher DoD priorities. ***FY 2014 Plans:*** N/A			
Title: Multi-Sensor Target Recognition ***Description:*** Develop and assess multi-sensor automatic target recognition for intelligence, surveillance, reconnaissance, strike, and weapon systems. ***FY 2012 Accomplishments:*** Completed assessment of multi-sensor automatic exploitation algorithms in non contested environments. Initiated development of new automatic target recognition fusion algorithm to overcome shortfalls. Assessed technology supporting intelligence, surveillance, and reconnaissance systems. Continued development of an automatic target recognition fusion sensor data exploitation capability utilizing analysis and experimentation of data independence and interdependence of features to support development of an optimum data fusion exploitation capability. ***FY 2013 Plans:*** Initiate technology assessment of intelligence, surveillance and reconnaissance systems in anti-access/area denial environments. Analyze unique technology requirements for new automatic target recognition fusion algorithms to address anti-access/area denial environments. Initiate research in exploitation algorithms supporting Planning, Collection, Processing, Analysis and Dissemination (PCPAD). Continue development of fusion algorithm for automatic target recognition and exploitation in non-contested environments. ***FY 2014 Plans:***	4.832	7.807	6.500

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603203F: *Advanced Aerospace Sensors*	PROJECT 6369DF: *Target Attack and Recognition Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue assessment of technology supporting intelligence, surveillance and reconnaissance systems in contested anti-access/ area denial environments. Continue development of new automatic target recognition fusion research to address technology gaps. Initiate research in development and assessment of multi-sensor automatic target recognition specifically for strike. Initiate spiral development of sensor exploitation algorithms of multi-sensor automatic target recognition systems supporting PCPAD.			
Title: Wide-Angle, Continuously-Staring Technologies ***Description:*** Develop wide angle, continuous staring, multi-sensor/wavelength sensing and automated exploitation technology to detect, track, and identify targets over large areas at low sensor update rates. ***FY 2012 Accomplishments:*** Developed, integrated, and tested the next spiral engineering model of the multi-sensor, multi-wavelength wide-angle, continuously-staring capability building upon the technologies developed during the previous demonstration. Integrated, demonstrated, and tested the enhanced wide angle, continuously-staring component technologies via a combination of exercises and scientific analyses. Conducted spiral development of wide angle, continuous staring exploitation algorithms, phenomenological modeling, target, and scenario databases necessary to support transition to the warfighter. ***FY 2013 Plans:*** Develop, integrate, and test the next spiral engineering model of the multi-sensor, multi-wavelength wide-angle, continuously-staring capability building upon the technologies developed during the previous demonstration. Continue to integrate, demonstrate, and test the enhanced wide angle, continuously-staring component technologies via a combination of exercises and scientific analyses. Continue spiral development of wide angle, continuous staring exploitation algorithms, phenomenological modeling, target, and scenario databases necessary to support transition to the warfighter. ***FY 2014 Plans:*** Initiate development of continuously-staring capability in contested and denied environments building upon the previous technologies developed for non-contested environments. Integrate, demonstrate and evaluate the enhanced wide angle, continuously-staring component technologies in contested and denied environments. Continue spiral development of wide angle, continuous staring exploitation algorithms, phenomenological modeling, target and scenario databases necessary to support transition to the warfighter.	3.815	6.225	4.730
Title: RF Persistent Sensing Technologies ***Description:*** Develop active RF sensor solutions to use against difficult-to-detect targets in challenging environments, and advanced RF architectures for open and reconfigurable systems. Enable persistent ISR over wide areas, and detect advanced air and ground targets. ***FY 2012 Accomplishments:***	5.231	3.798	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603203F: *Advanced Aerospace Sensors*	PROJECT 6369DF: *Target Attack and Recognition Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Conducted systems engineering and initiated development of dual-band wide-angle, continuously staring hardware and identifed platform integration. ***FY 2013 Plans:*** Complete development of dual-band system, and integrate on to identified platform. ***FY 2014 Plans:*** N/A. This effort completes in FY13.			
Accomplishments/Planned Programs Subtotals	25.922	21.388	13.930

	FY 2012	FY 2013
Congressional Add: Blue Devil 1 ***FY 2012 Accomplishments:*** Supported Blue Devil 1 operations in theater.	58.600	-
Congressional Adds Subtotals	58.600	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*					R-1 ITEM NOMENCLATURE PE 0603211F: *Aerospace Technology Dev/Demo*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	64.544	81.376	77.347	-	77.347	82.305	96.821	79.402	84.903	Continuing	Continuing
634920: *Flight Vehicle Tech Integration*	-	64.544	81.376	77.347	-	77.347	82.305	96.821	79.402	84.903	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program integrates and demonstrates advanced flight vehicle technologies that improve the performance and supportability of existing and future 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. Efforts in this program have been coordinated through the Department of Defese (DoD) science and Technology (S&T) Executive Committe process to harmonize efforts and eliminate duplication. 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 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	67.474	81.376	80.347	-	80.347
Current President's Budget	64.544	81.376	77.347	-	77.347
Total Adjustments	-2.930	0.000	-3.000	-	-3.000
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	-1.000	0.000			
• SBIR/STTR Transfer	-1.930	0.000			
• Other Adjustments	0.000	0.000	-3.000	-	-3.000

Change Summary Explanation

Decrease in FY 14 is due to higher DoD priorities.

Reprogrammed for specific projects in accordance with Section 219 of the Duncan Hunter National Defense Authorization Act for Fiscal Year (FY) 2009, as amended by Section 2801 of the National Defense Authorization Act for FY 2010.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603211F: *Aerospace Technology Dev/Demo*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Autonomous Flight Controls	13.006	5.416	3.556
Description: Develop autonomous flight controls for safe flight and cooperative operations between manned and remotely piloted air (RPA) platforms. ***FY 2012 Accomplishments:*** Developed and demonstrated technologies that provide situational awareness, autonomous control and survivability for remotely piloted systems and manned platforms. Continued efforts for cooperative teaming of small remotely piloted platforms in complex, low altitude environments. Initated testing of advanced control systems. Continued development of autonomous launch and safe airspace interoperability technologies for multiple remotely piloted systems. ***FY 2013 Plans:*** Continue development and demonstration of technologies for situational awareness, autonomous control, and survivability for unmanned systems and manned platforms. Demonstrate cooperative teaming of small unmanned platforms in complex, low altitude environments. Demonstrate autonomous launch and safe airspace interoperability for multiple remotely piloted systems. ***FY 2014 Plans:*** Further development and demonstration of technologies for situational awareness, autonomous control, and survivability for unmanned systems and manned platforms. Conclude demonstration of cooperative teaming of small unmanned platforms in complex, low altitude environments. Continue demonstration of autonomous and safe airspace interoperability for manned and RPA systems.			
Title: Enhanced Platform Capabilities	11.180	59.004	20.970
Description: Develop, simulate, and demonstrate integrated technologies to improve the performance of aerospace platform capabilities. ***FY 2012 Accomplishments:*** Continued work to develop and demonstrate flow control technologies for reducing acoustic loading and enhancing weapon separation from future strike platforms. Continued technology development efforts for cargo type platforms. Initiated combined high bypass ratio inlet and large fan technology demonstration. ***FY 2013 Plans:*** Complete lightweight composite structures ground experiment demonstration. Initiate technology efforts for precision air delivery capability for legacy mobility aircraft by reducing tracking errors and better integration of airdrop technologies. Mature adaptive turbine engine technologies for advanced air vehicles. Continue combined inlet and large bypass ratio fan demonstration. Begin			

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603211F: *Aerospace Technology Dev/Demo*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
demonstration of large cargo aircraft in formation flight for fuel burn reduction to support transition decision. Begin flight validation safety and operational compatibility of C-130 aircraft with aft body drag reduction devices. ***FY 2014 Plans:*** Further efforts for precision air delivery capability for legacy mobility aircraft by reducing tracking errors and better integration of airdrop technologies. Further development of advanced engine system design integration to mature adaptive turbine engine technologies for advanced air vehicles along with thrust augmentors and exhaust systems to provide technical options for highly fuel-efficient engines. Complete demonstration of large cargo aircraft in formation flight for fuel burn reduction to support transition decision. Complete flight safety validation and operational compatibility of C-130 aircraft with aft body drag reduction devices.			
Title: Multi-Role Structure Technologies ***Description:*** Develop aircraft structure technologies that have embedded components, which were previously separate components attached to the air platforms. ***FY 2012 Accomplishments:*** Continued flight test of antenna integration technology demonstration into load-bearing structures. Initiated demonstration efforts for reliability of unitized multi-role structure technologies. Demonstrated key high altitude persistent intelligence, surveillance, and reconnaissance (ISR) technologies. ***FY 2013 Plans:*** Continue flight test of antenna integration into load-bearing structures. Complete demonstrations of key high altitude persistent ISR technologies. Complete the demonstration of low band structurally integrated arrays and persistent multi-intelligence platforms. Develop passive flow control improvements for enhanced aero efficiency of legacy aircraft. ***FY 2014 Plans:*** Complete flight test of directional finding communication antenna integration technology demonstration into load-bearing structures for small RPA. Complete flight technology demonstrations of key high altitude persistent ISR for active flutter suppression, gust load alleviation, and adaptive, multi-purpose wing surfaces. Develop passive flow control technology improvements for enhanced aero efficiency of legacy aircraft. Initiate large scale conformal array technology demonstration into aircraft structure.	21.169	9.513	8.615
Title: Adaptive Structure Technologies ***Description:*** Develop technologies for adaptive structures to provide in-flight modifications offering improved performance. ***FY 2012 Accomplishments:***	11.127	1.139	0.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603211F: *Aerospace Technology Dev/Demo*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Furthered the demonstration of technologies necessary for reusable hypersonic vehicles. Assessed integrated structural health management technologies for lightweight remotely piloted air vehicles from subsonic to hypersonic speeds. Developed and assessed detailed integrated flight and ground systems concepts for operationally responsive space lift. ***FY 2013 Plans:*** Complete the development of integrated system health management and adaptive guidance and control technologies for aerospace vehicles. Complete structural health management ground technology demonstration for reusable space access vehicle. ***FY 2014 Plans:*** N/A.			
Title: High Speed/Hypersonic Vehicle Technologies ***Description:*** Develop, simulate and demonstrate integrated technologies to enable and improve the performance of high-speed and hypersonic air vehicles. ***FY 2012 Accomplishments:*** Continued efforts related to hypersonic ablation /shape-change measurement and prediction capabilities. Conducted hypersonic flight experiments. Continued efforts to study potential applications for utilizing high speed vehicles in ISR and strike missions. ***FY 2013 Plans:*** Complete demonstration of technologies necessary for reusable hypersonic vehicles and high-speed weapons and weapon systems. Continue to advance high temperature materials and structures for hypersonic vehicles. Continue small scale flight testing of high-speed flying experiments. ***FY 2014 Plans:*** Begin accelerated development and demonstration of tactically-relevant long range high speed strike technologies including ground and flight demonstrations needed for potential follow-on acquisition program. Effort builds upon successful scramjet engine demonstration under the X-51A program. Increase in FY14 also supports high speed/hypersonics testing support and continues to advance high temperature materials and structures for hypersonic vehicles.	8.062	6.304	44.206
Accomplishments/Planned Programs Subtotals	64.544	81.376	77.347

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603211F: *Aerospace Technology Dev/Demo*

E. Acquisition Strategy

Not Applicable.

F. 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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*					R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	115.725	151.152	149.321	-	149.321	141.759	151.529	124.519	123.874	Continuing	Continuing
632480: *Aerospace Fuels*	-	6.589	3.581	2.452	-	2.452	4.550	4.573	4.560	4.642	Continuing	Continuing
633035: *Aerospace Power Technology*	-	5.594	3.067	7.520	-	7.520	8.753	7.002	8.825	8.985	Continuing	Continuing
634921: *Aircraft Propulsion Subsystems Int*	-	17.240	77.716	64.176	-	64.176	47.209	58.399	39.617	37.448	Continuing	Continuing
634922: *Space & Missile Rocket Propulsion*	-	26.761	22.446	24.061	-	24.061	24.388	27.598	26.631	27.110	Continuing	Continuing
635098: *Advanced Aerospace Propulsion*	-	28.416	9.553	18.811	-	18.811	42.427	39.140	29.523	30.054	Continuing	Continuing
63681B: *Advanced Turbine Engine Gas Generator*	-	31.125	34.789	32.301	-	32.301	14.432	14.817	15.363	15.635	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 six projects, each focusing on technologies with a high potential to enhance the performance of existing and future Air Force weapons systems. The Aerospace Fuels project develops and demonstrates improved hydrocarbon fuels and advanced propulsion systems, including those for air-breathing high-speed/hypersonic flight. The Aerospace Power Technology project develops and demonstrates power and thermal management systems for weapons and aircraft as part of energy-optimized aircraft development. The Aerospace Propulsion Subsystems Integration project integrates the engine cores demonstrated in the Advanced Turbine Engine Gas Generator project with low-pressure components into demonstrator engines. The Space and Missile Rocket Propulsion project develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques. The Advanced Aerospace Propulsion project develops the scramjet propulsion cycle to a technology readiness level appropriate for in-flight demonstration and for full integration with other engine cycles (including turbine and rocket based). The Advanced Turbine Engine Gas Generator project develops and demonstrates core turbine engine technologies for current and future aircraft propulsion systems. Portions of the Aerospace Fuels, Advanced Turbine Engine Gas Generator, and Aerospace Propulsion Subsystems Integration projects support adaptive cycle technology demonstrations, which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. 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.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	120.924	151.152	153.221	-	153.221
Current President's Budget	115.725	151.152	149.321	-	149.321
Total Adjustments	-5.199	0.000	-3.900	-	-3.900
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	-1.999	0.000			
• SBIR/STTR Transfer	-3.200	0.000			
• Other Adjustments	0.000	0.000	-3.900	-	-3.900

Change Summary Explanation

Decrease in FY 2014 is due to higher DoD priorities.

Reprogrammed for specific projects in accordance with Section 219 of the Duncan Hunter National Defense Authorization Act for Fiscal Year (FY) 2009, as amended by Section 2801 of the National Defense Authorization Act for FY 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 632480: *Aerospace Fuels*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
632480: *Aerospace Fuels*	-	6.589	3.581	2.452	-	2.452	4.550	4.573	4.560	4.642	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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. 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Fuel-Related Thermal Management	1.000	0.500	0.341
Description: Demonstrate thermally stable fuels and fuel system hardware concepts to enhance cooling capacity (performance), minimize fuel coking, and reduce fuel system maintenance.			
FY 2012 Accomplishments: Demonstrated advanced fuel-based turbine engine cooling approaches.			
FY 2013 Plans: Evaluate fuel-related thermal management requirements of variable-cycle engines.			
FY 2014 Plans: Demonstrate fuel-cooled thermal management approaches for variable-cycle engines.			
Title: Gas Turbine Emissions	1.000	0.500	0.341
Description: Develop and demonstrate efficacy of low-cost, environmentally friendly fuel approaches to assess and reduce soot/ particulate emissions from gas turbine engines.			
FY 2012 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 632480: *Aerospace Fuels*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Demonstrated state-of-the-art soot/particulate diagnostics in full scale engine testing. ***FY 2013 Plans:*** Support development of international standard for soot (particulate) emissions from gas turbine engines. ***FY 2014 Plans:*** Demonstrate international standard methodology for measuring soot (particulates) on a variety of gas turbine engines. This measurement methodology will be transitioned through publication as a recommended international aerospace practice.			
Title: Fuel System Technologies ***Description:*** Develop and demonstrate enhancements to fuel system technology. ***FY 2012 Accomplishments:*** Demonstrated effective structural cooling of second generation endothermic fuels for hypersonic vehicles. ***FY 2013 Plans:*** Demonstrate effectiveness of JP-7 replacement endothermic fuel in reduced-scale cooling simulations to support medium-scale scramjet testing. ***FY 2014 Plans:*** Demonstrate effectiveness of enhanced endothermic fuel under higher heat sink conditions in reduced scale cooling simulations.	1.000	0.500	0.341
Title: Fuel Logistics ***Description:*** Identify, develop, and demonstrate low-cost approaches to reducing the fuel logistics footprint for the Air Force. ***FY 2012 Accomplishments:*** Evaluated fuel compositional relationship to biological growth. ***FY 2013 Plans:*** Demonstrate mitigation of biological growth in alternative fuels and commercial jet fuels in base-level fuel distribution systems. Evaluate effect of trace biodiesel contamination, resulting from transport via pipeline, on fuel properties and stability. ***FY 2014 Plans:*** Evaluate impact of commercial aviation jet fuel conversion (including alternative fuels) on Air Force fuel infrastructure.	0.770	0.800	0.545
Title: Alternative Jet Fuels ***Description:*** Characterize and demonstrate the use of alternative hydrocarbon jet fuel to comply with Air Force certifications and standards for jet fuels.	2.819	1.281	0.884

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 632480: *Aerospace Fuels*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Demonstrated improved alternative fuel combustion evaluation process to enable more rapid certification. Evaluated fully-synthetic biofuels in "fit-for-purpose" and rig testing to demonstrate durability. ***FY 2013 Plans:*** Evaluate "fit-for-purpose" properties of cellulosic-based alternative aviation fuels produced through thermo-catalytic processes. Initiate support to interagency combustor operability testing. Begin publishing research reports for industry review to faciliate development of consistent and common military and commercial fuel specifications. ***FY 2014 Plans:*** Evaluate "fit-for-purpose" properties of cellulosic-based alternative aviation fuels produced through fermentation processes. Continue to support interagency combustor operability testing. Continue to publish research reports for industry review to faciliate development of consistent and common military and commercial fuel specifications.			
Accomplishments/Planned Programs Subtotals	6.589	3.581	2.452

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 633035: *Aerospace Power Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
633035: *Aerospace Power Technology*	-	5.594	3.067	7.520	-	7.520	8.753	7.002	8.825	8.985	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 remotely piloted aircraft. The electrical power system components developed are projected to provide a two- to five-fold improvement in aircraft reliability and maintainability, and a reduction in power system weight. This project is integrated into energy optimized aircraft efforts 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Supporting Subsystem Directed Energy Weapon Technologies	0.200	0.000	0.000
Description: Develop electrical power and thermal management component subsystem technologies to integrate with and deliver high power for operation of directed energy weapons.			
FY 2012 Accomplishments: Supported integration of power and thermal management subsystems for flight demonstration of a high energy laser.			
FY 2013 Plans: Efforts in this area terminated due to higher DoD priorities.			
FY 2014 Plans: N/A			
Title: High Power Aircraft Subsystem Technologies	4.903	3.067	7.520
Description: Develop power generation/conditioning/distribution component, energy storage, and thermal management components and subsystem technologies for integration into high power aircraft.			
FY 2012 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 633035: *Aerospace Power Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Demonstrated robust, high power, high temperature power and thermal management subsystems as part of hardware in the loop validation and verification of system level, energy-optimized, air platform models. ***FY 2013 Plans:*** Demonstrate adaptive power and thermal management subsystems for next generation air platforms with potential transition to fifth generation strike aircraft via system level energy optimized air platform models. ***FY 2014 Plans:*** Complete demonstration of adapative power and thermal management subsystems for next generation air platforms and initiate integration of power and thermal management subsystems for platform level hardware-in-the-loop energy optimization demonstration. Facilitate technology and hardware integration for demonstration.			
Title: Small Remotely Piloted Aircraft Technologies ***Description:*** Develop hybrid electrical power and thermal management components and subsystem technologies for special purpose applications, enabling long endurance of small remotely piloted aircraft. ***FY 2012 Accomplishments:*** Demonstrated ruggedized high endurance small RPA hybrid power and thermal management subsystems. ***FY 2013 Plans:*** Efforts in this area terminated due to higher DoD priorities. ***FY 2014 Plans:*** N/A	0.491	0.000	0.000
Accomplishments/Planned Programs Subtotals	5.594	3.067	7.520

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 634921: *Aircraft Propulsion Subsystems Int*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
634921: *Aircraft Propulsion Subsystems Int*	-	17.240	77.716	64.176	-	64.176	47.209	58.399	39.617	37.448	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Aerospace Propulsion Subsystems Integration (APSI) project includes demonstrator engines for manned systems and concept and efficient small-scale propulsion for remotely piloted aircraft 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, this project includes activities to improve propulsion safety and readiness. This project also focuses on integration of inlets, nozzles, engine/airframe compatibility, and power and thermal management subsystems technologies. The APSI project 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. The APSI project 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. 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Turbofan/Turbojet Durability	1.800	0.500	0.960
Description: Design, fabricate, and demonstrate durability and integration technologies for turbofan/turbojet engines to improve durability, supportability, and affordability of Air Force aircraft.			
FY 2012 Accomplishments: Developed controls and accessories, health monitoring technologies, and light weight external components. Continued to assess and validate repair techniques.			
FY 2013 Plans: Investigate inlet and exhaust interactions.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 634921: *Aircraft Propulsion Subsystems Int*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to investigate inlet and exhaust interactions, active controls and accessories, and health monitoring technologies.			
Title: Turbofan/Turbojet Performance ***Description:*** Design, fabricate, and test advanced component technologies for improved performance and fuel consumption of turbofan/turbojet engines. ***FY 2012 Accomplishments:*** Completed manufacturing advanced adaptive cycle (third air stream) engine components, including an advanced fan, high work variable low turbine for long dwell time, controls, inlet integration, and advanced exhaust nozzle for subsonic to sustained supersonic flight. Conducted experimental testing of engine technologies. Continued preliminary design of high bypass/high overall pressure ratio engine technologies for improved fuel consumption. ***FY 2013 Plans:*** Finish assembly and instrumentation of advanced adaptive cycle (third air stream) engine technologies, including an advanced fan, high work variable low turbine for long dwell time, controls, inlet integration, and advanced exhaust nozzle for subsonic to sustained supersonic flight. Complete experimental testing of engine technologies. ***FY 2014 Plans:*** N/A	14.240	9.167	0.000
Title: Missile/Remotely Piloted Aircraft Engine Performance ***Description:*** Design, fabricate, and test component technologies for limited-life engines to improve the performance, durability, and affordability of missile and remotely piloted aircraft engines. ***FY 2012 Accomplishments:*** Completed detailed design and initiated fabrication of components of a higher specific thrust, low-cost expendable turbine engine for improved fuel efficiency to significantly improve range. Continued detailed design of fan, low spool turbine spool, and other engine components for advanced, fuel efficient subsonic unmanned turbofan engines. ***FY 2013 Plans:*** Complete assembly and instrumentation of supersonic, long endurance turbine engine components. Complete critical technology rig testing and begin sea level testing of supersonic, long endurance turbine engines. Increase in FY 2013 accelerates these engine components to support potential acquisition decision and need date. ***FY 2014 Plans:*** Complete ground testing of demonstration supersonic, long endurance turbine engines at simulated altitude conditions. Accelerate engine activity to meet follow on need date. Continue rig testing of advanced components for subsonic unmanned/	1.200	15.916	18.444

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 634921: *Aircraft Propulsion Subsystems Int*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
missile engine technology. Complete detailed design of subsonic small turbine engine technology. Begin preliminary design of subsonic mid sized turbine engine technology for remotely piloted aircraft. Increase in FY 2014 to ensure completion of rig testing and detailed design to support potential acquisition decision and need date.			
Title: Adaptive Turbine Engine Technologies ***Description:*** Design, fabricate, and demonstrate performance, durability, and operability technologies to mature adaptive turbine engine technologies. ***FY 2012 Accomplishments:*** N/A ***FY 2013 Plans:*** Initiate preliminary designs for an adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Accelerate engine technology development activity to meet follow on activity need date. Perform augmentor/ exhaust nozzle cold flow testing. Perform preliminary design of an advanced adaptive fan. Initiate long lead hardware procurement. ***FY 2014 Plans:*** Complete prelimary designs for an adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Initiate manufacturing of advanced adaptive fan and augmentor/exhaust rig test hardware. Accelerate engine technology development activity to meet to support transition for follow on activities.	0.000	52.133	44.772
Accomplishments/Planned Programs Subtotals	17.240	77.716	64.176

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 634922: *Space & Missile Rocket Propulsion*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
634922: *Space & Missile Rocket Propulsion*	-	26.761	22.446	24.061	-	24.061	24.388	27.598	26.631	27.110	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced and innovative low-cost rocket turbo-machinery and components, and low-cost space launch propulsion technologies. Additionally, this project develops technologies for the sustainment of strategic systems (including solid boost/missile propulsion, post boost control, and aging and surveillance efforts) and tactical rockets. Characteristics such as environmental acceptability, affordability, reliability, responsiveness, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion 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. 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 sustainment of the rocket propulsion industry, providing rocket propulsion technology for the entire Department of Defense and NASA.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Liquid Rocket Propulsion Technologies	20.751	19.680	20.204
Description: Develop liquid rocket propulsion technology for current and future space launch vehicles.			
FY 2012 Accomplishments: Completed the validation and verification of modeling and simulation tools developed for advanced cryogenic upper stage technologies. Continued development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept for future reusable launch vehicles. Continued subscale preburner and turbine component testing to demonstrate hydrocarbon boost technologies. Continued oxygen-rich material manufacturing scale-up effort to support hydrocarbon boost demonstration program. Conducted component scale-up and characterization for advanced hydrocarbon engine technologies using fuels other than kerosene.			
FY 2013 Plans: Continue development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept for future reusable launch vehicles. Continue sub-scale preburner and turbine component testing to demonstrate			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 634922: *Space & Missile Rocket Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
hydrocarbon boost technologies. Complete oxygen-rich material manufacturing scale-up effort to support hydrocarbon boost demonstration program. ***FY 2014 Plans:*** Continue development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept for future reusable and expendable launch vehicles. Complete sub-scale preburner and continue sub-scale turbine component testing to demonstrate hydrocarbon boost technologies. Conduct thrust chamber sub-scale development. Begin full-scale pre-burner component development.			
Title: On-Orbit Propulsion Technologies ***Description:*** Develop solar electric, electric, and monopropellant propulsion technologies for existing and future satellites, upper stages, orbit transfer vehicles, and satellite maneuvering. ***FY 2012 Accomplishments:*** Conducted scale-up of propulsion technologies for spacecraft with the need for high mobility on orbit. Completed hardware scale-up and conducted testing of hardware for an advanced multi-mode (high thrust or high efficiency) propulsion system for satellites. Built components for integration and demonstration of next generation of chemical thrusters for spacecraft propulsion systems. ***FY 2013 Plans:*** Efforts terminated in FY2013 due to higher DoD priorities. Propulsion unit for cubesats transitioned to customer for flight demonstration. High performance AF-M315E mono-propellant (non-toxic replacement for highly toxic Hydrazine) thruster technology transitioned to NASA for flight demo in FY15. ***FY 2014 Plans:*** N/A	3.344	0.000	0.000
Title: Ballistic Missile Technologies ***Description:*** Develop and demonstrate missile propulsion and post-boost control systems technologies for ballistic missiles. ***FY 2012 Accomplishments:*** Completed propellant component development and transition into next generation integrated motor demonstration. ***FY 2013 Plans:*** Develop advanced missile case, insulation, and nozzle technologies. Develop subscale component developments providing sub-scale validation of modeling and simulation tools. ***FY 2014 Plans:***	1.800	1.587	2.145

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 634922: *Space & Missile Rocket Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to develop advanced missile case, insulation, and nozzle technologies. Continue to develop subscale components providing sub-scale validation of modeling and simulation tools. Demonstrate prototype approach to thrust management.			
Title: Strategic System Motor Surveillance ***Description:*** Develop and demonstrate aging and surveillance technologies for strategic systems to reduce lifetime prediction uncertainty for individual motors, enabling motor replacement for cause. ***FY 2012 Accomplishments:*** Performed integration and full-scale demonstration of advanced aging and surveillance tools for solid rocket motors to validate and verify modeling and simulation tools and component technologies. ***FY 2013 Plans:*** Continue integration and full-scale demonstration of advanced aging and surveillance tools into solid rocket motors to validate and verify modeling and simulation tools and component technologies. ***FY 2014 Plans:*** Complete integration and full-scale demonstration of advanced aging and surveillance tools into solid rocket motors to validate and verify modeling and simulation tools and component technologies. Begin scale-up efforts to demonstrate previous technologies in full-scale applications. Begin development of next generation of sensors used for aging and surveillance.	0.866	1.179	1.712
Accomplishments/Planned Programs Subtotals	26.761	22.446	24.061

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 635098: *Advanced Aerospace Propulsion*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635098: *Advanced Aerospace Propulsion*	-	28.416	9.553	18.811	-	18.811	42.427	39.140	29.523	30.054	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 0.0 to 7.0. 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Scramjet Technologies	28.416	9.553	18.811
Description: Develop and demonstrate technologies for a hydrocarbon-fueled scramjet with robust operation over a range of Mach 4.0 to 7.0.			
FY 2012 Accomplishments: Conducted second flight test of a scramjet engine demonstrator. Analyzed second flight test data and conducted additional ground tests on inlet and fuel systems to determine cause of inlet unstart during transition from ethylene to JP-7. Made changes to X-51A in preparation for a third flight. Conducted third flight of X-51A. Post-test investigation determined that vehicle fin actuator unlocked shortly after separation from rocket booster, resulting in loss of vehicle during third flight. Conducted proof of concept test on cold start subsystems.			
FY 2013 Plans: Complete fourth flight test of a scramjet engine demonstrator. Analyze flight test data and complete final report. Continue development and demonstration of tactically compliant subsystems, including scramjet engine start system, fuel system, and engine controls. Complete component demonstration of tactically compliant cold start system. Initiate design of flight weight			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 635098: *Advanced Aerospace Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
scramjet engine cold start system, fuel system components, and advanced engine control system technologies. Decrease in FY13 due to higher DoD priorities. ***FY 2014 Plans:*** Continue development and demonstration of tactically compliant subsystems, including scramjet engine start system, fuel system, and engine controls. Initiate fabrication of flight weight ground test engine to demonstrate tactially compliant cold start system. Design and initiate fabrication of ground test flight weight engine components for High Speed Strike Weapon demonstration.			
Accomplishments/Planned Programs Subtotals	28.416	9.553	18.811

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 63681B: *Advanced Turbine Engine Gas Generator*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
63681B: *Advanced Turbine Engine Gas Generator*	-	31.125	34.789	32.301	-	32.301	14.432	14.817	15.363	15.635	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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, repairability, 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 the Aerospace Propulsion Subsystems Integration Project of this Program Element. 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Core Engine Technologies	17.927	15.322	11.030
Description: Design, fabricate, and demonstrate performance predictions in core engines, using innovative engine cycles and advanced materials for turbofan/turbojet engines.			
FY 2012 Accomplishments: Completed hardware fabrication, assembly and experimental demonstration of high temperature capable, durable compressor, combustor, and turbine technologies for adaptive core engines. Continued fabrication of component technologies and initiate assembly for a core-centric durability engine demonstration. Continued fabrication of component technologies for increased reliability, maintainability, and affordability for potential transition to fielded systems. Conducted detailed design of system-level technologies and weapon systems integration on core engine performance.			
FY 2013 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 63681B: *Advanced Turbine Engine Gas Generator*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Evaluate and conduct post demonstration assessment of high temperature capable, durable compressor, combustor, and turbine technologies for adaptive core engines. Complete fabrication of component technologies and assembly for a core-centric durability engine demonstration. Continue fabrication of component technologies for increased reliability, maintainability, and affordability for potential transition to fielded systems. ***FY 2014 Plans:*** Complete assembly and test of a core-centric durability engine technology demonstration. Complete fabrication of component technologies for increased reliability, maintainability, and affordability for potential transition to fielded systems. Initiate durability testing of component technologies.			
Title: High Pressure Ratio Core Engine Technologies ***Description:*** Design, fabricate, and demonstrate high overall pressure ratio cores to provide increased durability and affordability with lower fuel consumption for turbofan/turboshaft engines. ***FY 2012 Accomplishments:*** Continue selective risk reduction experimental demonstrations of small versatile affordable advanced core engine technologies for remotely piloted aircraft. Continue fabrication of efficient small engine component technologies including high efficiency, high pressure ratio, high temperature capability compressor, high heat release combustor, and high cooling effectiveness or uncooled turbine for use in both manned and umanned remotely piloted aircraft applications. Initiated conceptual design for advanced very efficient and very high pressure ratio core engine. Completed some compressor rig testing. ***FY 2013 Plans:*** Begin preliminary design of small efficient core engine concept with advanced technologies including high efficiency, high pressure ratio, high temperature capability compressor, high efficiency, high heat release combustor, and high work, high cooling effectiveness turbine with an integrated thermal management system and advanced mechanical systems. Decrease from FY 2012 to FY 2013 due to higher DoD priorities. ***FY 2014 Plans:*** Begin detailed design of small efficient core engine concepts with advanced technologies such as high pressure ratios, high temperature capability compressors, high heat release combustors, and high cooling effectiveness turbine with an integrated thermal management system and advanced mechanical systems.	13.198	3.500	1.200
Title: Adaptive Turbine Engine Core Technologies ***Description:*** Design, fabricate, and demonstrate performance, durability, and operability technologies to mature adaptive turbine engine core technologies.	0.000	15.967	20.071

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603216F: *Aerospace Propulsion and Power Technology*	PROJECT 63681B: *Advanced Turbine Engine Gas Generator*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: N/A ***FY 2013 Plans:*** Conduct design of core technologies for application to adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Perform power and thermal management system analysis and assessment. ***FY 2014 Plans:*** Complete preliminary design of core technologies for application to adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Initiate long lead hardware procurement and manufacturing of components for experimental core demonstration. Increase in FY 2014 supports execution and completion of preliminary design, purchases of raw materials for components, and contracts second and third tier turbine engine suppliers of components.			
Accomplishments/Planned Programs Subtotals	31.125	34.789	32.301

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*					R-1 ITEM NOMENCLATURE PE 0603270F: *Electronic Combat Technology*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	21.896	32.941	49.128	-	49.128	37.016	32.780	52.304	53.113	Continuing	Continuing
632432: *Defensive System Fusion Technology*	-	5.791	1.320	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
633720: *EW Quick Reaction Capabilities*	-	0.000	10.000	25.100	-	25.100	19.453	19.686	39.000	39.702	Continuing	Continuing
63431G: *RF Warning & Countermeasures Tech*	-	5.192	15.508	20.126	-	20.126	13.009	8.500	8.578	8.600	Continuing	Continuing
63691X: *EO/IR Warning & Countermeasures Tech*	-	10.913	6.113	3.902	-	3.902	4.554	4.594	4.726	4.811	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 four 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 integrates and focuses research efforts in electronic warfare (EW), directed energy weapons (DEW), and cyber warfare to rapidly demonstrate a capability for rapid fielding. The third project develops and demonstrates advanced technologies for radio-frequency electronic combat suites. The fourth project develops and demonstrates advanced warning and countermeasure technologies to defeat electro-optical, infrared, and laser threats to aerospace platforms. This program has been coordinated through the the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and electronic combat system developments that have military utility and address warfighter needs.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force					DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*			R-1 ITEM NOMENCLATURE PE 0603270F: *Electronic Combat Technology*		
B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	22.231	32.941	49.028	-	49.028
Current President's Budget	21.896	32.941	49.128	-	49.128
Total Adjustments	-0.335	0.000	0.100	-	0.100
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-0.335	0.000			
• Other Adjustments	0.000	0.000	0.100	-	0.100

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603270F: *Electronic Combat Technology*	PROJECT 632432: *Defensive System Fusion Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
632432: *Defensive System Fusion Technology*	-	5.791	1.320	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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, stand off 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 stand off jammer technologies, and electronic collection methods to inform field commanders of changes in the electronic environment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Integrated Electronic Warfare Technologies	5.791	1.320	0.000
Description: Develop affordable radio-frequency and electro-optical emitter warning and electronic warfare (EW) battle management technologies, integrating EW and information operations. ***FY 2012 Accomplishments:*** Increased maturity and performed demonstrations of electronic warfare battle management (EWBM) capabilities. Focused efforts on Distributed Electronic Attack concepts for specific threats and radar classes. Initiated effort in understanding and countering traditional and non-traditional targets in support of irregular warfare (IW). Developed a virtual EW/information operations (IO) battlespace environment for future project demonstrations, experiments, and assessments. ***FY 2013 Plans:*** Continue development of Distributed Electronic Attack concepts for specific threats and radar classes. ***FY 2014 Plans:*** This effort moves to Project 63431G in this PE to better align efforts.			
Accomplishments/Planned Programs Subtotals	5.791	1.320	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603270F: *Electronic Combat Technology*	PROJECT 632432: *Defensive System Fusion Technology*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603270F: *Electronic Combat Technology*	PROJECT 633720: *EW Quick Reaction Capabilities*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
633720: *EW Quick Reaction Capabilities*	-	0.000	10.000	25.100	-	25.100	19.453	19.686	39.000	39.702	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project establishes a capability to rapidly assess, develop and demonstrate new electronic warfare concepts, techniques, and capabilities in the context of systemic EW effects (EW-threat interactions) in a congested/contested electromagnetic spectrum (EMS), system-of-systems (SoS) environment of the future. It develops disruptive EW and countermeasures concepts specifically selected for high-impact, game-changing effects; evaluates them in high fidelity virtual and hardware evaluation settings; and demonstrates them in an operationally relevant environment. It establishes and maintains an all-source, physics-based, threat-to-countermeasures EW systems engineering methodology. It develops a core analytic function, supported by simulation-based wargaming and interactive engineering modeling capabilities to evaluate advanced countermeasures concepts.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Distruptive EW and Countermeasure Technologies	0.000	4.000	11.700
Description: Develop disruptive EW and countermeasure concepts specifically selected for rapidly fieldable, high-impact effects and demonstrate them in an operational environment. ***FY 2012 Accomplishments:*** N/A ***FY 2013 Plans:*** Initiate development of disruptive EW and countermeasure concepts and technologies initially identified for high-impact, game-changing effects in a contested EMS environment and begin initial evaluations thereof. ***FY 2014 Plans:*** Continue development of disruptive EW and countermeasures concepts and technologies specifically selected for high impact effects and demonstrate them in simulated or operational environments. Expand these systemic SoS developments to include GPS-denied techniques and technology solutions, networked-systems electronic protection (EP), and effects experimentation between/across EMS, cyber and directed energy (DE) domains.			
Title: Threat-to-Countermeasure System of Systems (SoS) Methods	0.000	3.000	5.800
Description: Establish and maintain an all-source, physics-based, design-level, red-blue, comparative, threat-to-countermeasure SoS techniques methodology. This systems engineering-based EW approach will inform programmatic planning, quantify			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603270F: *Electronic Combat Technology*	PROJECT 633720: *EW Quick Reaction Capabilities*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
desirable research areas with realistic SoS metrics, and foster improved understanding of future concept contributions to EW warfighting capabilities. ***FY 2012 Accomplishments:*** N/A ***FY 2013 Plans:*** Initiate development of an all-source, physics-based, design-level, red-blue, comparative, threat-to-countermeasure SoS techniques methodology. ***FY 2014 Plans:*** Continue development of an all source, physics based, design level, red-blue, comparative, threat-to countermeasure SoS techniques methodology for use in concept development and simulation based testing. Initiate integration of SoS engineering methods across virtual/modeling, hardware-in-the-loop (HWIL) and systems integration lab (SIL) options to optimize end-to-end (threat-to-countermeasure) systemic effects.			
Title: Evaluation of Advanced Countermeasure Concepts ***Description:*** Develop a core analytic function, supported by a simulation-based wargaming and engineering modeling capabilities, for evaluation, development, and demonstration of advanced EW, cyber, DE and integrated/systemic, non-kinetic concepts to include special capability programs. ***FY 2012 Accomplishments:*** N/A ***FY 2013 Plans:*** Initiate development of a core analytic function, supported by a simulation-based wargaming and engineering modeling capabilities, for evaluation, development, and demonstration of advanced EW, cyber, DE and integrated systemic, non-kinetic concepts to include special capability programs. ***FY 2014 Plans:*** Continue development of a core analytical function, supported by a simulation based war gaming and engineering modeling capabilities, for evaluation, development, and demonstration of advanced countermeasure concepts to include special capability programs. Expand evaluation capabilities to incorporate full systemic EMS effects and netted/distributed EW capabilities in anti-access/area denial (A2/AD) scenarios.	0.000	3.000	7.600
Accomplishments/Planned Programs Subtotals	0.000	10.000	25.100

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603270F: *Electronic Combat Technology*	PROJECT 633720: *EW Quick Reaction Capabilities*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603270F: *Electronic Combat Technology*	PROJECT 63431G: *RF Warning & Countermeasures Tech*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
63431G: *RF Warning & Countermeasures Tech*	-	5.192	15.508	20.126	-	20.126	13.009	8.500	8.578	8.600	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Electronic Attack	5.192	15.508	20.126
Description: Develop aerospace platform jamming technologies and techniques to counter advanced radio-frequency (RF) threats associated with current and future aerospace weapon systems.			
FY 2012 Accomplishments: Demonstrated adaptable electronic attack (EA) technique concepts against a modeled threat environment. Initiated effort to develop a Network electronic support/electronic attack (ES/EA) Experiments Lab. Demonstrated a cognitive jammer system concept in a laboratory environment. Defined and analyzed proactive electronic protection (EP) concepts. Conducted effort on next generation RF threats and potential EW concepts.			
FY 2013 Plans: Continue to demonstrate adaptable electronic attack (EA) technique concepts against a modeled threat environment. Continue to develop and demonstrate a cognitive jammer system concept in a laboratory environment. Continue to assess and analyze proactive electronic protection (EP) concepts. Continue effort to focus on next generation RF threats and potential EW concepts.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603270F: *Electronic Combat Technology*	PROJECT 63431G: *RF Warning & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to develop and demonstrate adaptable electronic attack (EA) technique concepts, cognitive jammer system concepts, and advanced EP concepts to defeat next generation RF threats,with a major emphasis on penetrating contested, anti-access/ area denial environments.			
Accomplishments/Planned Programs Subtotals	5.192	15.508	20.126

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603270F: *Electronic Combat Technology*	PROJECT 63691X: *EO/IR Warning & Countermeasures Tech*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
63691X: *EO/IR Warning & Countermeasures Tech*	-	10.913	6.113	3.902	-	3.902	4.554	4.594	4.726	4.811	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Advanced EO/IR Warning and Countermeasure Technologies	10.913	6.113	3.902

Description: Analyze the vulnerabilities of current infrared missile systems and future imaging infrared sensors. Develop advanced countermeasure system technologies to exploit vulnerabilities for use against infrared and electro-optical guided missile threats. Develop advanced optical and infrared sensor systems for airborne and space situational awareness and threat warning.

FY 2012 Accomplishments:

Developed, tested, and refined infrared countermeasures concepts and techniques against current infrared missile systems and future advanced threat sensors. Developed surrogate imaging sensors, processors, and track algorithms to test and evaluate countermeasure concepts against advanced threat systems. Developed new laser warning concepts and simulation capability to address emerging directed energy threats to provide situational awareness and threat warning. Initiated space situational awareness sensor prototype experiment phase II.

FY 2013 Plans:

Continue to develop, test, and refine infrared countermeasures concepts and techniques against current infrared missile systems and future advanced threat sensors. Continue development of surrogate imaging sensors, processors, and track algorithms to test and evaluate countermeasure concepts against advanced threat systems. Perform advanced proactive infrared countermeasures (PIRCM) search, detect, and countermeasure research. Develop concepts for protection of postulated future threats to 6th generation aircraft including definition of component and subsystem requirements.

FY 2014 Plans:

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603270F: *Electronic Combat Technology*	PROJECT 63691X: *EO/IR Warning & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue to develop, test, and refine infrared countermeasures concepts with emphasis on penetrating contested, anti-access/ area denial environments. Continue development of surrogate imaging sensors, processors, and track algorithms and perform advance proactive infrared countermeasure (PIRCM) search, detect, and countermeasure research. Develop concepts for protection of postulated future threats to 6th generation aircraft including definition of component and subsystem requirements.			
Accomplishments/Planned Programs Subtotals	10.913	6.113	3.902

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*					R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	70.643	64.557	68.071	-	68.071	69.975	51.193	52.117	53.293	Continuing	Continuing
632181: *Spacecraft Payloads*	-	17.601	15.710	16.492	-	16.492	11.306	11.192	11.604	12.004	Continuing	Continuing
633834: *Integrated Space Technology Demonstrations*	-	33.388	13.828	11.817	-	11.817	18.121	17.101	18.192	18.607	Continuing	Continuing
634400: *Space Systems Protection*	-	4.889	5.047	5.611	-	5.611	5.954	6.213	6.384	6.515	Continuing	Continuing
634950: *Space Demonstration*	-	0.000	16.000	15.000	-	15.000	11.500	0.000	0.000	0.000	Continuing	Continuing
635021: *Space Systems Survivability*	-	2.960	2.907	3.361	-	3.361	3.191	3.244	3.304	3.365	Continuing	Continuing
635083: *Ballistic Missiles Technology*	-	5.785	5.081	5.487	-	5.487	6.356	6.460	6.570	6.682	Continuing	Continuing
63682J: *Spacecraft Vehicles*	-	6.020	5.984	10.303	-	10.303	13.547	6.983	6.063	6.120	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program develops, integrates, and demonstrates space technologies in the areas of spacecraft payloads, spacecraft protection, spacecraft vehicles, ballistic missiles, and space systems survivability. The integrated space technologies are demonstrated by component or system level tests on the ground or in flight. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. 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 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	74.009	64.557	61.690	-	61.690
Current President's Budget	70.643	64.557	68.071	-	68.071
Total Adjustments	-3.366	0.000	6.381	-	6.381
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	-1.909	0.000			
• SBIR/STTR Transfer	-1.457	0.000			
• Other Adjustments	0.000	0.000	6.381	-	6.381

Change Summary Explanation

Increase in FY14 is due to increased emphasis on positioning, navigation, and timing space payload technologies and space communications.

Reprogrammed for specific projects in accordance with Section 219 of the Duncan Hunter National Defense Authorization Act for Fiscal Year (FY) 2009, as amended by Section 2801 of the National Defense Authorization Act for FY 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 632181: *Spacecraft Payloads*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
632181: *Spacecraft Payloads*	-	17.601	15.710	16.492	-	16.492	11.306	11.192	11.604	12.004	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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. Future 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, this project merges 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 (DoD) 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Advanced Space Electronics	6.650	7.047	5.285
Description: Develop microelectronic devices, including radiation-hardened data processors and high-density hardened memories, advanced packaging technologies, and micro-electro-mechanical system components and applications. ***FY 2012 Accomplishments:*** Completed development of Single Event Immune Reconfigurable Field Programmable Gate Array for flexible, cost-effective on-board processing in space. Developed multiprocessor components to increase on-orbit processing capability. Developed high-density volatile and non-volatile memory for increased on-orbit storage capability. ***FY 2013 Plans:*** Continue to develop multiprocessor components to increase on-orbit processing capability. Continue to develop high-density volatile and non-volatile memory for increased on-orbit storage capability. Complete digital structured application specific integrated circuits for affordable space electronics. ***FY 2014 Plans:*** Focus development of multiprocessor components to reduce power required for on-orbit processing capability. Develop volatile memory for satellite high-density data storage capability. Begin to develop analog structured application specific integrated circuits for affordable space electronic support logic.			
Title: Spacecraft Design Tools	2.467	1.991	1.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 632181: *Spacecraft Payloads*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: Develop satellite system technologies for spacecraft operations and for satellite control, precision navigation, formation flying, and proximity operations technologies. ***FY 2012 Accomplishments:*** Completed rapid spacecraft development processes for automated spacecraft design, rapid assembly, automated flight and ground software configuration, and expedited integration and test. Initiated second-generation plug-and-play ground testbed to fully test and demonstrate end-to-end flight ready spacecraft plug-and-play software and hardware. Began plug-and-play network analysis for impact on spacecraft performance. Assisted space acquisitions with plug-and-play technology assessment. Supported Air Force development of a plug-and-play based space vehicle. ***FY 2013 Plans:*** Continue development and use of second-generation plug-and-play ground testbed to fully test and demonstrate end-to-end flight ready spacecraft plug-and-play software and hardware. Support transition of spacecraft modular component technology to large spacecraft. Continue assisting space acquisitions with modular space component technology assessment. Continue supporting Air Force development of a modular component based space vehicle. ***FY 2014 Plans:*** Continue development, refinement and use of modular space component ground testbed. Mature plug-and-play standards and structure. Continue supporting Air Force development of a plug-and-play based space vehicle. Note: Funding for space plug-and-play technology development reduced due to higher AF priorities.			
Title: Advanced Space Modeling and Simulation Tools ***Description:*** Develop modeling, simulation, and analysis tools for space-based surveillance systems, space capability protection technologies, access/mobility technologies, and flight experiments. ***FY 2012 Accomplishments:*** Completed integration of autonomous flight software technologies with command, control, guidance, and navigation technologies. Applied additional physics-to-engineering-to-engagement level models for systems engineering, technology trades, mission planning and operations, and utility analysis to satellite experiments in space superiority mission areas. ***FY 2013 Plans:*** Validate the guidance, navigation, and control aspects of the autonomous flight software using the mission simulator flight software. Continue to provide engineering to engagement level models for systems engineering and trades, mission planning, and utility analysis to flight experiments and research areas. ***FY 2014 Plans:***	4.343	2.781	2.864

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 632181: *Spacecraft Payloads*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Validate system to mission-level modeling and simulation tools for flight program mission planning. Finalize data requirements for upcoming flight programs to gather critical validation data on orbit to enhance previously developed modeling and simulation tools. Evaluate the military and technical utility of emerging space vehicle technologies and associated software algorithms.			
Title: Advanced Space Sensors ***Description:*** Develop space infrared technology and hardened focal plane detector arrays to enable acquisition, tracking, and discrimination of hot objects, as well as "cold body" objects. ***FY 2012 Accomplishments:*** Developed full focal plane array for exquisite imaging for adaptive, comprehensive space situational awareness (SSA). Initiated higher operating temperature, large format medium wavelength infrared sensor development for wide area, global access detection and tracking. ***FY 2013 Plans:*** Continue large focal plane array development for exquisite imaging for adaptive, comprehensive SSA. Continue development of higher operating temperature, large format medium wavelength infrared sensors for wide area, global access detection and tracking. ***FY 2014 Plans:*** Continue developing wide field of view large focal plane array for theater missile warning, missile detection, and battlespace awareness. Initiate radiation hardened visible scanning effort to improve sensor capabilities for comprehensive SSA.	4.141	3.891	3.343
Title: Positioning, Navigation, and Timing (PNT) Space Payload Technologies ***Description:*** Develop technologies for the NavSat payload (PNT only) that enhance the affordability, resiliency and availability of accuracy of the GPS constellation. ***FY 2012 Accomplishments:*** N/A ***FY 2013 Plans:*** N/A ***FY 2014 Plans:***	0.000	0.000	4.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 632181: *Spacecraft Payloads*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Begin to develop advanced solid state power amplifier and reprogrammable flexible digital waveform generator for NavSat PNT payload. Initiate studies to identify other high payoff technologies to support the NavSat Global Positioning Sytem (GPS) augmentation deployment.			
Accomplishments/Planned Programs Subtotals	17.601	15.710	16.492

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 633834: *Integrated Space Technology Demonstrations*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
633834: *Integrated Space Technology Demonstrations*	-	33.388	13.828	11.817	-	11.817	18.121	17.101	18.192	18.607	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Integrated Satellite Demonstrations	33.388	13.828	11.817
Description: Develop satellite technologies for integrated, robust, flexible, satellite demonstrations building on previous work and leveraging investments by other organizations. ***FY 2012 Accomplishments:*** Completed integration/test and space environmental testing in preparation for launch of experimental satellite for geosynchronous orbit. Completed ground system software for use in space operations. Began design of next geosynchronous space flight demonstration. ***FY 2013 Plans:*** Complete satellite integration to the launch vehicle. Complete satellite flight software and orbit analysis tools for commanding satellite. Completed final testing of the satellite before it is put in storage to await a launch. Continue design of next geosynchronous space flight demonstration. ***FY 2014 Plans:*** Begin space flight operations of geosynchronous orbit satellite demonstrating advanced autonomy technologies. Continue maintenance and debugging of geosynchronous orbit experimental satellite flight software and orbit analysis tools. Procure long-lead components, the platform, and Air Force payloads for planned demonstration of an augmented Evolved Expendable Launch Vehicle Secondary Payload Adaptor geosynchronous orbit experiment.			
Accomplishments/Planned Programs Subtotals	33.388	13.828	11.817

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 633834: *Integrated Space Technology Demonstrations*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 634400: *Space Systems Protection*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
634400: *Space Systems Protection*	-	4.889	5.047	5.611	-	5.611	5.954	6.213	6.384	6.515	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 and avoiding threats and operating in a hostile space environment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Space Situational Awareness Capability Development	2.922	2.898	2.510
Description: Develop tools and technologies that advance space-based proximity awareness capabilities and enable protection and countermeasure courses of action. Efforts will assess a variety of phenomenologies and concepts in response to multiple threat classes and scenarios.			
FY 2012 Accomplishments: Constructed and tested hardware and software for innovative deep space imaging concepts, conducted empirical experiments on test coupons for broad-spectrum effort, and used the results to create a predictive signature capability.			
FY 2013 Plans: Using results from deep-space imaging experiments, develop a brass board system traceable to a potential space-based capability. Repeat developmental performance tests on brass board hardware and software to verify expected performance. Conduct experiments to verify performance of predictive signature efforts.			
FY 2014 Plans: Using experimental test results from deep-space imaging experiments, conduct an engineering trade study for a space-based concept.			
Title: Space Indicators and Warning Research	0.787	1.715	2.755
Description: Develop passive satellite countermeasures and mitigation techniques for current and future threats to satellites.			
FY 2012 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 634400: *Space Systems Protection*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Identified local area sensors for indication and warnings concepts for engineering unit development. Assessed novel imaging techniques and post-processing algorithms to improve detection and identification. Completed systems engineering study to identify stakeholder courses of action in anomalous conditions and identified decision-maker information needs driving technology development. Began process to identify future flight opportunity. ***FY 2013 Plans:*** Initiate local area sensor for indication and warnings engineering unit development. Design concept for integrated sensor suite and response system for automated response options. Continue to identify future flight opportunity. ***FY 2014 Plans:*** Continue local area sensor for indication and warning engineering unit development. Continue design concept for integrated sensor suite and response system for automated response options. Begin integration of technologies with identified flight opportunity.			
Title: Spacecraft Threat Detection ***Description:*** Develop active satellite local space awareness technologies. Develop advanced exploitation tools for satellite systems. ***FY 2012 Accomplishments:*** Designed on-orbit threat detection, assessment, and response software systems. Focused technology development effort on on-orbit intelligent control of surveillance payloads. Explored technology for miniaturization of sensor concepts and improved dynamic sensitivity of sensor components. ***FY 2013 Plans:*** Demonstrate a modular satellite autonomy flight architecture with responsive action to a selected directed energy threat to a hypothetical friendly satellite. This includes the capability to detect threats on-board and provide autonomous potential courses of action to mitigate the postulated threat. ***FY 2014 Plans:*** Expand satellite autonomy architecture and demonstrate threat/anomaly detection and response with real-time sensor processing and control.	0.894	0.145	0.346
Title: Satellite RF Characterization ***Description:*** Develop RF characterization methods and performance analysis technology. ***FY 2012 Accomplishments:***	0.286	0.289	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 634400: *Space Systems Protection*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Evaluated sensing techniques for potential active and/or passive threat detection and tracking capabilities. Developed requirements and concepts to reduce vulnerabilities to next generation U.S. satellites. ***FY 2013 Plans:*** Develop engineering model sensor sub-systems for active and/or passive threat detection and tracking capabilities. Initiate technology risk reduction for U.S. satellite vulnerability mitigation. ***FY 2014 Plans:*** This thrust has been combined with Space Indicators and Warning Research in order to better align counterspace science and technology efforts.			
Accomplishments/Planned Programs Subtotals	4.889	5.047	5.611

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 634950: *Space Demonstration*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
634950: *Space Demonstration*	-	0.000	16.000	15.000	-	15.000	11.500	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project will provide mission design and development, payload integration, launch support, operations planning, and one-year of on-orbit operations for a science and technology space-launch mission. The project will provide a launch opportunity in support of the multi-agency "new entrant" certification strategy and the Air Force Launch Services New Entrant Certification Guide.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: S&T Space Launch Integration and Test	0.000	16.000	15.000
Description: Provide mission design and development, payload integration, launch support, operations planning, and one-year of on-orbit operations for a science and technology space-launch mission while supporting the multi-agency "new entrant" certification strategy. ***FY 2012 Accomplishments:*** N/A ***FY 2013 Plans:*** Provide mission definition, design, development, and operations planning. Select and/or refine satellite and payload manifest. Initiate planning and integration of satellites and payloads onto launch vehicle. ***FY 2014 Plans:*** Provide mission definition, design, development, and operations planning. Refine satellite and payload manifest. Continue planning and integration of satellites and payloads onto launch vehicle.			
Accomplishments/Planned Programs Subtotals	0.000	16.000	15.000

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
• 0: *N/A*	0.000	0.000	0.000		0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 634950: *Space Demonstration*

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 635021: *Space Systems Survivability*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635021: *Space Systems Survivability*	-	2.960	2.907	3.361	-	3.361	3.191	3.244	3.304	3.365	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Spacecraft Survivability/Reliability	2.960	2.907	3.361
Description: Develop technologies to provide improved space radiation and ionospheric hazard specification and forecasting. ***FY 2012 Accomplishments:*** Developed advanced standard model of radiation belts, using data from recently launched space environment instruments. Completed trade studies to narrow alternatives for a second-generation heliospheric imager for detecting and tracking solar coronal mass ejections (CMEs) which threaten space systems and degrade communications. Completed development of a more precise CME propagation model to enhance space weather forecasting tools. ***FY 2013 Plans:*** Improve software tools to model surface and deep charging, radiation dose rate to spacecraft in real-time for evaluation of spacecraft anomalies. Continue development of an engineering model of an improved instrument to measure high-energy electrons and protons that contribute to radiation dose and spacecraft charging. Continue advanced development of concepts and technology for an operational capability in heliospheric imaging. ***FY 2014 Plans:*** Exploit on-orbit data to improve accuracy of standard radiation belt model for satellite design. Continue development of advanced data and modeling techniques to increase accuracy of spacecraft anomaly attribution. Complete engineering model and begin construction of compact space environment sensor flight unit. Implement material aging models into spacecraft charging design tool. Develop technologies supporting next-generation upgrades to the Air Force's solar optical, radio, and imaging network.			
Accomplishments/Planned Programs Subtotals	2.960	2.907	3.361

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 635021: *Space Systems Survivability*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 635083: *Ballistic Missiles Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635083: *Ballistic Missiles Technology*	-	5.785	5.081	5.487	-	5.487	6.356	6.460	6.570	6.682	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops, integrates, and demonstrates advanced technologies for sustainment and modernization of strategic ballistic missiles. The project focuses on developing robust, low maintenance inertial navigation instruments to sustain current ballistic missile systems, as well as provide new, small, low-powered, high-precision instrumentation for next generation missile systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Advanced Navigation Instruments	5.785	5.081	5.487
Description: Develop, integrate, and demonstrate advanced navigation instrumentation applied to emerging vehicle designs and other technologies that support warfighter needs for a safe, secure, and reliable strategic deterrence. ***FY 2012 Accomplishments:*** Started follow-on effort to address next generation guidance and navigation technologies for future systems. Developed technologies that facilitate planned Analysis of Alternatives on next generation strategic weapons. Completed the build and tested Advanced Inertial Measurement Unit (AIMU) engineering model for enhanced ground testing and preparation for flight test. ***FY 2013 Plans:*** Improve AIMU design based on engineering model testing. Begin engineering model build of AIMU for validation of performance in a sled test. Begin preliminary design for hardening of AIMU to weapons level radiation hardness. Begin development of technologies for next generation strategic weapons requirements. ***FY 2014 Plans:*** Continue design and build of fully weapons hardened AIMU design to meet Minuteman III requirements. Continue ground testing to include captive carry flight testing on a Navy test pod.			
Accomplishments/Planned Programs Subtotals	5.785	5.081	5.487

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 635083: *Ballistic Missiles Technology*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 63682J: *Spacecraft Vehicles*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
63682J: *Spacecraft Vehicles*	-	6.020	5.984	10.303	-	10.303	13.547	6.983	6.063	6.120	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops and demonstrates compact, low-cost, spacecraft power generation, storage, distribution, and thermal management technologies, including cryogenic cooling technologies. This project also develops composites for spacecraft structures and technologies for spacecraft control and mechanisms.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Space Power Technologies	1.382	2.188	1.375
Description: 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. ***FY 2012 Accomplishments:*** Extended inverted metamorphic (IMM)-based solar cell development toward 35-37% efficiency. Conducted maturity development of quantum dot-enhanced IMM solar cells. ***FY 2013 Plans:*** Complete development of efficient 34% IMM solar cell. Continue development of 35-37% IMM and quantum-dot enhanced IMM solar cells. Continue maturation of IMM solar cell interconnection and module technologies. ***FY 2014 Plans:*** Complete development of efficient 35% IMM solar cell. Continue development of 36-37% IMM and quantum dot enhanced IMM solar cells. Complete IMM solar cell interconnection and continue maturation of module technologies.			
Title: Spacecraft Thermal Technologies	1.554	0.891	0.984
Description: Develop technologies for long-life, efficient, low-vibration, lightweight mechanical cryocoolers and integration components for space applications. ***FY 2012 Accomplishments:*** Worked to reduce size, weight, and power requirements, ease integration, and increase reliability of cryocoolers and supporting payload thermal management systems for very large format focal plane arrays for missile warning capability and for other			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 63682J: *Spacecraft Vehicles*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
modular systems. Evaluated passive versus active cooling, based on heat loads, power requirements, size, and payload thermal modeling. Provided correlated computer modeling results to industry to improve overall cryocooler design. ***FY 2013 Plans:*** Continue to reduce size, weight, and power requirements, ease integration, and increase reliability of cryocoolers and supporting payload thermal management systems for very large format focal plane arrays for missile warning capability and for industry to significantly improve overall cryocooler design. Expand computer modeling to cover additional cryocooler components, including the pulse tube, and provide correlated results to industry. ***FY 2014 Plans:*** Using correlated computer modeling results, continue to reduce size, weight, and power requirements, ease integration, and increase reliability of cryocoolers and supporting payload thermal management systems for very large format focal plane arrays for missile warning capability and for industry to significantly improve overall cryocooler design. Further expand computer modeling to additional cryocooler components, to include flow straightening effects and other refrigeration cycles (reverse Brayton), and provide correlated results to industry.			
Title: Spacecraft Structures Technologies ***Description:*** Develop composites for spacecraft structures and space applications, such as launch vehicle shrouds, thermal protection structures, and space antennas. ***FY 2012 Accomplishments:*** Completed development of thermal management testbed for space structures. Initiated development of system-level deployable architectures for advanced optical systems and low-cost RF reflectors. ***FY 2013 Plans:*** Develop capability for providing structural dynamics data on large, deployable apertures for space systems. Develop technologies and processes for rapid calibration of payloads for space applications. ***FY 2014 Plans:*** Perform data analysis on variable heat transfer modulation experiment aboard the International Space Station. Produce flight-representative deployable baffle and folded optics for compact star-trackers and wide-field-of-view imagers.	1.338	1.338	1.698
Title: On-Orbit Satellite Controls ***Description:*** Develop technologies for spacecraft controls and mechanisms for on-orbit applications. ***FY 2012 Accomplishments:***	1.746	1.567	0.300

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 63682J: *Spacecraft Vehicles*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Transitioned high accuracy star tracker flight unit for use in customer flight program. Refined SSA camera tracking software in preparation for flight test. Completed hardware development of momentum control systems (control-moment gyroscopes) for small satellites to improve system agility. Designed an autonomous mission manager for flight autonomy and on on-orbit planning systems. Implemented flight-like processors with hardware-in-the-loop to increase technical maturity. ***FY 2013 Plans:*** Demonstrate and transition SSA camera tracking software. Demonstrate momentum control systems (control-moment gyroscopes) for small satellites in relevant environment. Initiate advanced spacecraft guidance, navigation, and control subsystem hardware development efforts. ***FY 2014 Plans:*** Continue advanced spacecraft guidance, navigation, and control subsystem hardware development efforts.			
Title: Space Communication and Control Technologies ***Description:*** Develop technologies for next-generation space communications terminals and equipment, along with methods/ techniques to enable future space system operational command and control concepts. ***FY 2012 Accomplishments:*** N/A ***FY 2013 Plans:*** N/A ***FY 2014 Plans:*** Develop satellite communication flight experiments to support future Air Force satellite systems, particularly reconfigurable/ reprogrammable satellite transceivers, space laser communication terminals, and millimeter wave atmospheric propagation experiments.	0.000	0.000	5.946
Accomplishments/Planned Programs Subtotals	6.020	5.984	10.303

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603401F: *Advanced Spacecraft Technology*	PROJECT 63682J: *Spacecraft Vehicles*

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 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603444F: *Maui Space Surveillance System (MSSS)*

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
Total Program Element	-	13.313	29.256	26.299	-	26.299	15.774	13.202	10.728	10.922	Continuing	Continuing
634868: *Maui Space Surveillance System*	-	13.313	29.256	26.299	-	26.299	15.774	13.202	10.728	10.922	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program funds ground-based optical 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. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. 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 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	13.555	29.256	26.299	-	26.299
Current President's Budget	13.313	29.256	26.299	-	26.299
Total Adjustments	-0.242	0.000	0.000	-	0.000
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-0.225	0.000			
• Other Adjustments	-0.017	0.000	0.000	-	0.000

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Operate and Upgrade MSSS	13.313	19.944	15.944
Description: Operate and upgrade MSSS to support development, demonstration, and integration of ground-based optical SSA technologies.			
FY 2012 Accomplishments:			

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603444F: *Maui Space Surveillance System (MSSS)*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Upgraded MSSS control room. Operated MSSS facility for development and demonstration of ground-based optical SSA capabilities such as characterization and identification of space objects. ***FY 2013 Plans:*** Maintain MSSS facility and experimental equipment in a mission-ready state. Deliver upgraded Laser Guidestar system at MSSS. Begin refurbishment of existing domes with repaint, new gaskets to prevent leaking and advanced electronics. Operate MSSS facility for development and demonstration of ground based optical SSA capabilities such as characterization and identification of space objects. Develop procedures supporting a new mix of research, customer programs, and operational SSA support. ***FY 2014 Plans:*** Maintain MSSS facility and experimental equipment in a mission-ready state. Perform needed upgrades and modernization to keep facilities and equipment in good working order and allow MSSS to perform efficiently and reliably. Install and perform testing of the upgraded Laser Guidestar system at MSSS. Implement procedures and operate MSSS facility for development and demonstration of ground based optical SSA capabilities in conjunction with customer programs and an operational SSA mission.			
Title: Geosynchronous Object Sensor ***Description:*** Develop and demonstrate dual-use integrated sensor technology for imaging of geosynchronous objects as well as other long-range applications. ***FY 2012 Accomplishments:*** N/A ***FY 2013 Plans:*** Begin development of dual-use sensor technology for identification of objects in geosynchronous orbit. ***FY 2014 Plans:*** Develop laser detection and ranging transceiver and conduct initial low-power technology demonstration for imaging objects in geosynchronous orbit.	0.000	9.312	10.355
Accomplishments/Planned Programs Subtotals	13.313	29.256	26.299

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603444F: *Maui Space Surveillance System (MSSS)*

F. 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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*					R-1 ITEM NOMENCLATURE PE 0603456F: *Human Effectiveness Advanced Technology Development*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	24.082	21.523	20.967	-	20.967	21.520	17.561	16.738	16.523	Continuing	Continuing
635323: *Directed Energy Bioeffects Parameters*	-	2.202	1.040	3.700	-	3.700	3.600	2.700	2.700	2.590	Continuing	Continuing
635324: *Human Dynamics and Terrain Demonstration*	-	9.949	9.988	8.640	-	8.640	9.339	7.697	7.312	7.493	Continuing	Continuing
635325: *Mission Effective Performance*	-	4.985	3.925	2.336	-	2.336	2.685	1.994	2.006	2.042	Continuing	Continuing
635327: *Warfighter Interfaces*	-	6.946	6.570	6.291	-	6.291	5.896	5.170	4.720	4.398	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Human Dynamics and Terrain Demonstration project develops, demonstrates, and transitions human-centric technologies to address processing, exploitation, and dissemination of intelligence, surveillance, and reconnaissance (ISR) capability needs. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies to protect and enhance the performance of Air Force personnel in operational environments.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force					DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*			R-1 ITEM NOMENCLATURE PE 0603456F: *Human Effectiveness Advanced Technology Development*		
B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	25.283	21.523	17.088	-	17.088
Current President's Budget	24.082	21.523	20.967	-	20.967
Total Adjustments	-1.201	0.000	3.879	-	3.879
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	-0.686	0.000			
• SBIR/STTR Transfer	-0.515	0.000			
• Other Adjustments	0.000	0.000	3.879	-	3.879

Change Summary Explanation

Increase in FY 2014 is due to increased focus on Directed Energy Bioeffects.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603456F: *Human Effectiveness Advanced Technology Development*	PROJECT 635323: *Directed Energy Bioeffects Parameters*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635323: *Directed Energy Bioeffects Parameters*	-	2.202	1.040	3.700	-	3.700	3.600	2.700	2.700	2.590	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 thrust develops and demonstrates technologies that counter optical threats, while exploiting optical systems for non-lethal applications. The radio frequency (RF) radiation bioeffects thrust develops and demonstrates technologies to assess RF bioeffects and collateral hazards from high power RF directed energy systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Optical Radiation Bioeffects	0.819	0.820	2.229
Description: Develop and demonstrate optical protective technologies for aircrew and ground personnel to provide protection against directed energy threats. Develop modeling capabilities to assess collateral hazards from high power directed energy laser systems.			
FY 2012 Accomplishments: Tested end-to-end laser eye protection (LEP) design capability by merging frame and format design capability with a visual performance metrics and modeling capability to create a single, integrated package allowing complete human systems integration of LEP. Validated microwave modeling and simulation tool. Developed software to incorporate RF energy-induced human effects from collateral hazard predictions into wargaming scenarios. Increased computational speed of collateral hazard predictions for near-real-time modules for weapon system fire control and mission planning applications.			
FY 2013 Plans: Integrate and test physics-based modeling techniques for advanced LEP in next generation cockpit scenarios for human systems integration and protection. Integrate laser bioeffects models and collateral effects algorithms into high-fidelity predictions of high energy laser weapons effects to enable safe testing of weapons effects and demonstrator concepts. Benchmark collateral hazard prediction algorithms for lasers.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603456F: *Human Effectiveness Advanced Technology Development*	**PROJECT** 635323: *Directed Energy Bioeffects Parameters*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Merge a frame and format design capability with a visual performance metrics and modeling capability to create a single, integrated package allowing complete human systems integration of LEP. Use three-dimensional (3-D) optical modeling tools to quantify and visually render the effects of LEP filters on human vision. Participate in demonstration of mission planning analysis tool for optimization of directed energy/kinetic energy weapons use. Validate bioeffects models. Begin integration of probabilistic tools into high energy laser collateral damage models.			
Title: Radio Frequency Bioeffects: ***Description:*** Develop and demonstrate technologies to assess RF bioeffects and collateral hazards from high power RF directed energy systems. ***FY 2012 Accomplishments:*** Tested and validated high energy laser collateral effects real-time predictive models for directed energy weapon systems. Integrated directed energy hazard assessment tools in wargaming scenarios. Tested and validated near-real-time modules for weapon system fire control and mission planning applications. ***FY 2013 Plans:*** Demonstrate validated microwave modeling and simulation tools to non-lethal RF weapon wargames for realistic human effects. ***FY 2014 Plans:*** Identify candidate directed energy weapons system and begin to incorporate real-time collateral effects and hazard calculations into weapon systems. Participate in demonstration of mission planning analysis tool for optimization of directed energy/kinetic energy weapons use. Validate bioeffects models. Begin integration of RF bioeffects real-time model and control algorithms into RF weapons to optimize non-lethal human effects while minimizing collateral damage from RF weapons.	1.383	0.220	1.471
Accomplishments/Planned Programs Subtotals	2.202	1.040	3.700

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603456F: *Human Effectiveness Advanced Technology Development*	PROJECT 635324: *Human Dynamics and Terrain Demonstration*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635324: *Human Dynamics and Terrain Demonstration*	-	9.949	9.988	8.640	-	8.640	9.339	7.697	7.312	7.493	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops, demonstrates, and transitions technologies to identify human threats within the air, space, and cyber domains. These technologies will enhance Air Force capabilities in ISR, layered sensing, autonomous and adaptive decision-making systems, decision aids for computer network attack/defense/support, ISR force development and training, anticipatory command, control, and intelligence (C2I), measures of enhanced psychological operations, cross-cultural communication, and human-centric exploitation of measurement and signatures intelligence.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Human Analyst Augmentation	4.287	3.144	3.040

Description: Develop/demonstrate human-centered design processes and operational tools that optimize ISR information flows in a distributed, multisource mission planning environment. Develop/demonstrate anticipatory C2I decision-aiding technologies to rapidly assess battlefield behaviors, and select/prioritize courses of action. Develop/demonstrate anticipatory C2I decision-aiding technologies to rapidly assess battlefield situation, predict likely adversary behaviors, and select/prioritize courses of action.

FY 2012 Accomplishments:

Delivered software prototype of unified analytical tool kit and work environment to support increased analyst speed and more robust, inclusive decision-making with lower cognitive overhead. Delivered prototype human-inspired cueing system to speed image analysis. Developed and tested new methods to support visualization and manipulation of large, abstract data sets by combining recent advances in neuroscience and neuroimaging
techniques with neural-based feature extraction and data filtering. Built in-house prototype to rapidly and effectively detect and correlate relationships with patterns of life and anomalous threat detection and identification.

FY 2013 Plans:

Develop an analyst testbed concept for evaluating effectiveness of analyst tool integration in the processing, exploitation, and dissemination process. Develop work aids for intelligence analysts and tools for collaborative synthesis and social cogitive analysis.

FY 2014 Plans:

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603456F: *Human Effectiveness Advanced Technology Development*	PROJECT 635324: *Human Dynamics and Terrain Demonstration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Demonstrate work aids for intelligence analysts and tools for collaborative synthesis and social cognitive analysis. Demonstrate human-centric analytic work environment for intelligence analysis and behavioral influence analysis. Assess effectiveness of analyst aids in the processing, exploitation, and dissemination process.			
Title: Human Trust and Interaction ***Description:*** Develop/demonstrate technology to optimize human operator performance, adversarial modeling techniques, and automated speech translation tools to aid Air Force information/influence operations. ***FY 2012 Accomplishments:*** Developed advanced techniques to rapidly develop and easily maintain speech-to-speech translation systems in multiple languages and application domains with limited data availability. ***FY 2013 Plans:*** Develop tools, algorithms, and techniques that can be used for domain specific automatic speech recognition, machine translation, and natural language processing components in new languages and domains, especially those characterized by minimal data availability. ***FY 2014 Plans:*** Mature human language technologies to develop tools that improve the effectiveness of ISR operators and intelligence analysts. Develop, assess, and test capabilities against specific customer data sets, especially those characterized by scientific and technical terminology. Evaluate and integrate algorithms into frameworks supporting ISR collection and exploitation.	2.077	2.500	2.400
Title: Human Signatures ***Description:*** Apply human threat signatures to enhance threat detection training for intelligence analysts, reconnaissance patrol, and force protection security operators. ***FY 2012 Accomplishments:*** Developed training based on physical/physiological indicators of deceptive behavior. Initiated development of software training module for human threat indicators. Provided requirements for sensor resolution and optimized sensor placement for human threat indicator detection. ***FY 2013 Plans:*** Develop human threat recognition capabilities by creating libraries of human signatures to include simple and complex motions and biofidelic avatars with variable dimensions in gender, age, size, and shape. Demonstrate initial libraries in joint virtual training software for human threat recognition and feasibility for integration into future on-board sensor systems. ***FY 2014 Plans:***	3.585	4.344	3.200

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603456F: *Human Effectiveness Advanced Technology Development*	PROJECT 635324: *Human Dynamics and Terrain Demonstration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Initiate multimodal exploitation of signatures through fusion of radar, electro-optical, and infrared sensing. Collect outdoor signatures for hyperspectral and polarized light with realistic background. Begin development on multimodal avatar with radar output and morphology governing size, shape, and motion definition. Begin development of an on-the-job training platform for ISR analysts.			
Accomplishments/Planned Programs Subtotals	9.949	9.988	8.640

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603456F: *Human Effectiveness Advanced Technology Development*	PROJECT 635325: *Mission Effective Performance*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635325: *Mission Effective Performance*	-	4.985	3.925	2.336	-	2.336	2.685	1.994	2.006	2.042	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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. Focus areas include integrated high-fidelity weapon systems training technologies for air, space, and cyber; tailored immersive simulation environments for airmen at the tactical and operational levels; and incorporating performance assessment and feedback tools. These methods and technologies facilitate the development of mission-essential competencies.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Continuous Learning	1.962	3.925	2.336
Description: Develop and demonstrate secure, persistent, and standardized LVC training enterprise. ***FY 2012 Accomplishments:*** Conducted initial evaluations of the reconfigurable and deployable training environment for Air Force applications. Completed evaluation for deployable training for Combatant Commander capability assessment across LVC contexts. Completed specification development for an integrated learning assessment and management system for Distributed Mission Operations (DMO) and LVC operations. Defined data and interoperability standards for remotely piloted aircraft (RPA) sensor and pilot training integration in LVC operations. Developed and demonstrated learning management tools. Demonstrated integration of performance metrics in the after action review tool kit. ***FY 2013 Plans:*** Demonstrate learning managed LVC for fifth generation air combat mission training. Develop joint criteria, models, and tools for environment certification applicable across LVC contexts. Demonstrate standardized process and integrated toolsets for correlated simulation database development. ***FY 2014 Plans:*** Complete development, demonstration, and initial transition of learning management system for DMO and LVC operations. Initiate development of standards for shareable scenario content, data, and metrics.			
Title: DMO Training/Rehearsal	3.023	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603456F: *Human Effectiveness Advanced Technology Development*	**PROJECT** 635325: *Mission Effective Performance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: Develop/demonstrate high-fidelity DMO training/rehearsal capability for Air and Space Operations Center (AOC) operators. ***FY 2012 Accomplishments:*** Completed development of immersive training for operational planning prototype training system for AOC Combat Plans Division. Demonstrated scenario development and execution management for training for one AOC planning team. Evaluated prototype in deliberate planning phases and execution phases of operations. ***FY 2013 Plans:*** Work Completed in FY 2012. ***FY 2014 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	4.985	3.925	2.336

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603456F: *Human Effectiveness Advanced Technology Development*	PROJECT 635327: *Warfighter Interfaces*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635327: *Warfighter Interfaces*	-	6.946	6.570	6.291	-	6.291	5.896	5.170	4.720	4.398	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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, multisensory fusion, high-resolution image displays, and 3-D 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Applied Neuroscience	3.915	1.831	0.800

Description: Develop sense, assess, and augment technologies to facilitate efficient workflow in distributed operational environments. Develop empirically validated cyber operator-centered tools for distributed cyber operations integrated into a single user interface.

FY 2012 Accomplishments:

Developed technology to assess the value of operator immersion and related virtual presence technology for improving human and mission performance, designed novel warfighter visualizations, and developed intuitive control methods for exercising telepresence in the urban battlespace. Developed conceptual operator telepresence technology interfaces (remote and on-scene) for the larger context of supervisory control of the sensor networks and ISR services. Assessed hardware and software technology options for developing team workload and performance detection capability and visualization requirements. Began to develop and plan to integrate both on-human and off-human sensor technologies. Worked with command and control operational users from control and reporting centers to identify characteristics of team membership and visualization requirements.

FY 2013 Plans:

Develop neurophysiologic sensored technology for determining operator workload. Integrate neurophysiologic sensors with automated system adaptation methods, software, and tools. Identify visualization, tool composition, and user interface requirements to support cyber operations. Analyze human operator team composition and requisite skill sets based upon cyber

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603456F: *Human Effectiveness Advanced Technology Development*	PROJECT 635327: *Warfighter Interfaces*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
tool set composition and information flow. Based upon human-computer interface requirements analyses, provide training recommendations for the transition of cyber offensive tools and technologies to the operational community. ***FY 2014 Plans:*** Complete analysis of human operator team composition and requisite skill sets based upon cyber tool set composition, operational information flow, and concept of operations. Begin initial design of an integrated offensive and defensive cyber operator tool set.			
Title: Battlespace Acoustics ***Description:*** Demonstrate ability to forecast acoustic profiles for any atmospheric/terrain condition. Demonstrate technologies to enhance the battlefield airman's situational awareness through wearable interfaces. ***FY 2012 Accomplishments:*** Integrated a high-fidelity acoustic simulation model into existing Air Force fielded software applications to demonstrate technology in the user's environment. Performed initial proof-of-concept verification and validation of the integrated acoustic model. Developed and tested field data collection procedures to validate the acoustic predictions of sound propagation and source characterization. Collected soundscape data for a background noise database. Performed related research on human hearing and vigilance. ***FY 2013 Plans:*** Develop 3-D acoustic models of manned and unmanned aircraft for incorporation into high-fidelity acoustic mission planning tools. Collect high-fidelity 3-D acoustic measurements of manned and unmanned aircraft. Determine aural detectability across a wide range of weather conditions, geography, and background sounds. Employ usability engineering methodologies to establish user requirements and use-case scenarios for the pararescue jumper community. Prototype designs of wearable interface concepts. ***FY 2014 Plans:*** Refine high fidelity 3-D acoustic models for integration into mission planning tools. Validate acoustic models against real-world data obtained from airborne platform measurements. Incorporate weather effects, landscape sounds, and geography into acoustic models. Develop prototype user interfaces based on pararescue jumper requirements and use-case scenarios. Refine wearable interface designs based on operator feedback.	0.971	2.735	3.475
Title: Human Role in Semiautonomous Systems ***Description:*** Develop and demonstrate an integrated human-centered interface to control multiple RPAs that have various levels of autonomy and that optimize net-centric information flow. ***FY 2012 Accomplishments:***	1.032	2.004	2.016

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603456F: *Human Effectiveness Advanced Technology Development*	PROJECT 635327: *Warfighter Interfaces*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Analyzed warfighter requirements for a future generation control station that will accommodate advanced and legacy RPAs. Developed and integrated operator interface controls, displays, and decision-aid technologies for effective situation assessment, decision-making, and action implementation to manage semiautonomous, multimission RPAs and heterogeneous payloads. Tested control station technology to determine baseline functionality and performance. ***FY 2013 Plans:*** Validate warfighter requirements for the next generation operator control station that will accommodate advanced and legacy RPAs. Integrate and test technologies for operator interface controls, displays, and decision-aids to manage multimission RPAs and payloads. Conduct prototype evaluations of operator interface controls. Perform initial testing of technologies designed to assess the value of RPA operator immersion and telepresence for improving human and mission performance. ***FY 2014 Plans:*** Integrate, test, and evaluate operator interface designs to support decision making and situation awareness while controlling multiple advanced and legacy RPAs in a dynamic mission environment. Develop multi-transit control station interface technology to enable a single pilot to simultaneously control multiple RPAs transiting through airspace. Begin developing and evaluating interface controls for a networked RPA collaborative environment allowing teams of pilots along with sensor and payload operators to work together during stringent mission phases.			
Title: Space Visualization ***Description:*** Develop and demonstrate space visualization technologies that provide visually intuitive awareness of the battlespace, including trend portrayal useful for decision making. ***FY 2012 Accomplishments:*** Examined and analyzed the workflow and information required to provide warfighters with an inherent awareness of the operational space situation. Exploited available cognitive task analyses of space operations and developed user requirements for visualization tools that simplify the process of portraying relevant data from large data sets. Developed and tested laboratory prototypes of visualization tools developed from user-derived requirements. ***FY 2013 Plans:*** Work completed in FY 2012. ***FY 2014 Plans:*** N/A	1.028	0.000	0.000
Accomplishments/Planned Programs Subtotals	6.946	6.570	6.291

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603456F: *Human Effectiveness Advanced Technology Development*	PROJECT 635327: *Warfighter Interfaces*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603601F: *Conventional Weapons Technology*

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
Total Program Element	-	44.057	36.352	33.996	-	33.996	43.589	46.601	47.585	48.459	Continuing	Continuing
63670A: *Conventional Weapons Development*	-	44.057	36.352	33.996	-	33.996	43.589	46.601	47.585	48.459	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program develops, demonstrates, and integrates advanced ordnance and guidance technologies for air-launched conventional weapons. The program focuses on conventional ordnance component technologies such as warheads, fuzes, and explosives, as well as munition guidance component technologies such as navigation and control systems and seekers. Technologies to be developed, demonstrated, and integrated address blast, fragmentation, penetration, low-collateral damage, variable depth/location fuzing, precise guidance, and high performance and insensitive explosives. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	45.542	36.352	33.996	-	33.996
Current President's Budget	44.057	36.352	33.996	-	33.996
Total Adjustments	-1.485	0.000	0.000	-	0.000
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	-0.574	0.000			
• SBIR/STTR Transfer	-0.911	0.000			
• Other Adjustments	0.000	0.000	0.000	-	0.000

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Ordnance Technologies	28.307	18.000	6.500

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603601F: *Conventional Weapons Technology*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: Develop and demonstrate ordnance technologies to improve conventional, air-delivered munitions. Specific technical areas of focus include fuzes, energetic materials, and warheads. ***FY 2012 Accomplishments:*** Demonstrated survivability of components for a conventional ordnance package capable of penetrating high performance concrete with high-speed sled tests. Performed system trades to assess approaches for incorporating velocity boosting for a penetrating warhead. Developed an ordnance package that enables the warfighter to tailor the weapon effects for the target and its surrounding environment. ***FY 2013 Plans:*** Continue developing technologies for a conventional ordnance package capable of penetrating high performance concrete at velocities up to 2,500 feet per second. Continue developing and demonstrating technologies and approaches that incorporate velocity augmentation capability for penetrating weapons. Continue developing an ordnance package that enables the warfighter to tailor the weapon effects for the target and its surrounding environment. Investigate alternate fuze concepts to increase the reliability of penetrating weapons. ***FY 2014 Plans:*** Complete demonstrations of a conventional ordnance package capable of penetrating high performance concrete at velocities up to 2,500 feet per second. Complete demonstration of technologies that incorporate velocity augmentation capability for penetrating weapons. Continue developing an ordnance package that enables the warfighter to tailor the weapon effects for the target and its surrounding environment. Develop alternate fuze technologies to increase the reliability of penetrating weapons.			
Title: Guidance Technologies ***Description:*** Develop and demonstrate guidance technologies to improve the precision, controlled lethality, and flexibility of conventional, air-delivered munitions. Specific technical areas include precision navigation and terminal seekers. ***FY 2012 Accomplishments:*** Completed demonstration of dynamic path planning and target engagement technologies for close controlled strike munitions concepts. Developed algorithms for precision weapon navigation in Global Positioning System (GPS)-degraded environments for strict control of angle of attack. ***FY 2013 Plans:*** Continue developing technology for precision weapon navigation in GPS-degraded environments. Develop technologies capable of guiding a high-speed strike weapon characterized by very high terminal speed and high end-game maneuverability. ***FY 2014 Plans:***	9.688	7.800	11.700

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603601F: *Conventional Weapons Technology*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Demonstrate simulations of weapon navigation and control necessary for penetration into hard targets at high velocities. Demonstrate technologies for precision weapon navigation in GPS-degraded environments. Continue to develop technologies capable of guiding a high-speed strike weapon characterized by very high terminal speed and high end-game maneuverability.			
Title: Advanced Munition Concept Technologies ***Description:*** Demonstrate advanced conventional munition concepts. These innovative concepts integrate ordnance, guidance, and carriage and release technologies to demonstrate warfighter capability. ***FY 2012 Accomplishments:*** Began demonstrating technologies that enable a munition to provide effects tailorable to the target and surrounding environment. Refined employment concepts and system technologies for high-speed penetrating weapons with velocity augmentation. Continued developing missile technologies, primarily focused on increasing kinematic performance, to defeat a broad range of small and highly agile air targets, as well as high value ground targets, such as enemy air defenses. Performed an integrated demonstration of the guidance, navigation and control functions to attack multiple moving vehicles with several small, powered, precision guided submunitions. ***FY 2013 Plans:*** Complete development of missile technologies to defeat a broad range of small and highly agile air targets, as well as high value ground targets, such as enemy air defenses. Continue to refine employment concepts and system technologies for high-speed penetrating weapons with velocity augmentation. Continue development of a munition concept to incorporate technologies for carriage and terminal impact at high-speed. Increase emphasis on munition concepts that increase the capacity and capability of fifth-generation aircraft. ***FY 2014 Plans:*** Complete demonstration of technologies for high-speed penetrating weapons with velocity augmentation. Investigate concepts for cooperative control of small weapons to produce scalable effects to increase the capacity and capability of fifth-generation aircraft. Develop and demonstrate ordnance and guidance technologies for tactically relevant long range strike weapons and reduce risk for a potential follow-on acquisition program.	6.062	10.552	15.796
Accomplishments/Planned Programs Subtotals	44.057	36.352	33.996

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603601F: *Conventional Weapons Technology*

E. Acquisition Strategy

N/A

F. 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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*					R-1 ITEM NOMENCLATURE PE 0603605F: *Advanced Weapons Technology*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	45.823	19.004	19.000	-	19.000	25.374	27.053	27.799	28.313	Continuing	Continuing
633150: *Advanced Optics Technology*	-	20.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
633151: *Lasers and Imaging Development and Integration*	-	14.795	9.313	9.518	-	9.518	17.843	15.880	16.524	14.087	Continuing	Continuing
633152: *High Power Microwave Development and Integration*	-	11.028	9.691	9.482	-	9.482	7.531	11.173	11.275	14.226	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program provides for the development, integration, demonstration, and detailed assessment of directed energy weapon technologies including high energy laser, high power electromagnetics (HPEM), and other unconventional weapon generation and transmission technologies, which can support a wide range of Air Force applications. The program develops a corresponding susceptibility, vulnerability, and lethality database for directed energy weapons. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	48.666	19.004	19.950	-	19.950
Current President's Budget	45.823	19.004	19.000	-	19.000
Total Adjustments	-2.843	0.000	-0.950	-	-0.950
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	-2.127	0.000			
• SBIR/STTR Transfer	-0.733	0.000			
• Other Adjustments	0.017	0.000	-0.950	-	-0.950

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603605F: *Advanced Weapons Technology*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2012	FY 2013
Project: 633150: *Advanced Optics Technology*		
Congressional Add: *Space Situational Awareness.*	20.000	-
Congressional Add Subtotals for Project: 633150	20.000	0.000
Congressional Add Totals for all Projects	20.000	0.000

Change Summary Explanation

Reprogrammed funds for higher Air Force priorities; Reprogrammed for specific projects in accordance with Section 219 of the Duncan Hunter National Defense Authorization Act for Fiscal Year (FY) 2009, as amended by Section 2801 of the National Defense Authorization Act for FY 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603605F: *Advanced Weapons Technology*	PROJECT 633150: *Advanced Optics Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
633150: *Advanced Optics Technology*	-	20.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops advanced optical technologies for various strategic and tactical beam control applications.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013
Congressional Add: Space Situational Awareness.	20.000	-
FY 2012 Accomplishments: Conducted Congressionally-directed effort.		
Congressional Adds Subtotals	20.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603605F: *Advanced Weapons Technology*	PROJECT 633151: *Lasers and Imaging Development and Integration*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
633151: *Lasers and Imaging Development and Integration*	-	14.795	9.313	9.518	-	9.518	17.843	15.880	16.524	14.087	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project provides for the development, integration, demonstration, and detailed assessment of high energy laser and beam control technologies needed for applications such as force protection, force application, precision engagement, and aircraft self-protection. Laser system concept assessments to include vulnerability assessments and target effect testing are performed.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: High Energy Laser/Beam Control	14.795	9.313	9.518
Description: Develop and demonstrate advanced beam control technologies, integrated laser systems, and aircraft self-protection laser technologies. Demonstrate beam control components integrated with high energy lasers for military utility. ***FY 2012 Accomplishments:*** With DARPA, prepared to integrate a high energy electric laser device with a beam control subsystem on the ground. Developed technologies and concepts for the integration of a high power electric laser and a beam control system. Developed an integrated breadboard to demonstrate focal plane array damage technologies for aircraft self-protection. ***FY 2013 Plans:*** Complete build-up and characterization of the beam control system and complete the Acquisition Tracker Interface, and the Command and Control code for the Air Force/DARPA demonstration of an integrated high energy electric laser device with a beam control subsystem on the ground. Integrate the DARPA device with the beam control system. Investigate subsystem and system level capability concepts that integrate technologies for aircraft self-protection. ***FY 2014 Plans:*** With DARPA, conduct high power testing against static and moving targets using the integrated high energy electric laser device and beam control system on level ground and from a 3000 foot high peak. Continue to plan technologies and develop concepts for a future airborne electric laser. Plan aircraft self-protection field testing.			
Accomplishments/Planned Programs Subtotals	14.795	9.313	9.518

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603605F: *Advanced Weapons Technology*	PROJECT 633151: *Lasers and Imaging Development and Integration*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603605F: *Advanced Weapons Technology*	PROJECT 633152: *High Power Microwave Development and Integration*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
633152: *High Power Microwave Development and Integration*	-	11.028	9.691	9.482	-	9.482	7.531	11.173	11.275	14.226	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops and demonstrates high power electromagnetics (HPEM) 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. It also provides inputs to the susceptibility, vulnerability, and lethality databases.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: HPEM Technologies	11.028	9.691	9.482
Description: Develop and evaluate HPEM and other unconventional weapon technologies for various platforms, including aerial, for applications such as counter-electronics. Develop and evaluate HPEM technologies for non-lethal, anti-personnel weapon applications. ***FY 2012 Accomplishments:*** Prepared for a FY 2013 flight demonstration of the high power microwave (HPM) payload for the Counter-Electronics HPM Airborne Munition Program (CHAMP) Joint Capability Technology Demonstration (JCTD) against a wide range of targets in multiple buildings. Evaluated the effectiveness of CHAMP in a static test against the various targets. ***FY 2013 Plans:*** Conducted a very successful flight test of the HPM payload for the CHAMP JCTD. Analyze the large amount of data from the flight test. Develop and evaluate technologies to reduce size, weight, and power consumption for compact multi-pulse HPM system in an integrated platform with anti-tamper and battle damage assessment capabilities. ***FY 2014 Plans:*** Evaluate four candidate source technologies for potential use in a multi-target, reusable HPM counter-electronics munition demonstrator. Develop and evaluate technologies to reduce size, weight, and power consumption for a compact multi-pulse system in an integrated platform with anti-tamper and battle damage assessment capabilities.			
Accomplishments/Planned Programs Subtotals	11.028	9.691	9.482

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603605F: *Advanced Weapons Technology*	PROJECT 633152: *High Power Microwave Development and Integration*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*					R-1 ITEM NOMENCLATURE PE 0603680F: *Manufacturing Technology Program*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	39.165	37.045	41.353	-	41.353	41.444	38.884	41.233	41.975	Continuing	Continuing
635280: *Manufacturing Technologies*	-	38.275	37.045	41.353	-	41.353	41.444	38.884	41.233	41.975	Continuing	Continuing
635281: *Manufacturing Readiness*	-	0.890	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

The Manufacturing Technology (ManTech) program executes technical programs to maintain and develop an affordable and reliable industrial base and manufacturing capability that will be responsive to warfighter needs. The program develops and improves manufacturing technologies and processes to enable cost reduction, improve component and system quality, and enhance industrial capability. Further, value stream modifications and manufacturing throughput improvements are effected to shorten cycle times of weapon systems during design, development, production and sustainment. ManTech objectives are conducted through industrial partnerships which enable the demonstration of manufacturing technologies for existing weapon system upgrades and/or for new warfighter systems. Efforts in the program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. 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.

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	40.103	37.045	36.353	-	36.353
Current President's Budget	39.165	37.045	41.353	-	41.353
Total Adjustments	-0.938	0.000	5.000	-	5.000
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-0.938	0.000			
• Other Adjustments	0.000	0.000	5.000	-	5.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603680F: *Manufacturing Technology Program*

Change Summary Explanation

Increase in FY14 is due to increased emphasis on agile manufacturing capability for intelligence, surveillance, and reconnaissance components to reduce manufacturing risk.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603680F: *Manufacturing Technology Program*	PROJECT 635280: *Manufacturing Technologies*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635280: *Manufacturing Technologies*	-	38.275	37.045	41.353	-	41.353	41.444	38.884	41.233	41.975	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

The Manufacturing Technology (ManTech) program executes technical programs to maintain and develop an affordable and reliable industrial base and manufacturing capability that will be responsive to warfighter needs. The projects include development and improvement of manufacturing technologies and processes; collaboration with government program offices, industry, and academia; investments in generic technologies that can be applied to different applications; cost-sharing; multiple system/customer applications; potential for significant return on investment; and customer commitment to implement. To this end, ManTech develops and demonstrates advanced manufacturing processes and technologies to reduce costs, improve quality/capability, and shorten cycle times of weapon systems during design, development, production, and sustainment. Where mature processes are not available, laboratory-developed and demonstrated initial process capabilities are made available for transition into weapon system programs. ManTech objectives are conducted through partnerships with all industry levels, from large prime contractors to small material and parts vendors.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Sustainment Manufacturing Technologies	15.465	12.798	12.500
Description: Develop and implement cost-effective maintenance, repair, and manufacturing technologies for sustainment of Air Force weapon systems.			
FY 2012 Accomplishments: Continued efforts for cost-effective development of conventional and low-observable repair and manufacturing technologies enabling affordable sustainment of aircraft and turbine engine components. Continued assessments and manufacturing technology development to reduce logistics support costs, lead times for high value supply chain commodities, and cycle times for depot repair. Continued efforts supporting High Velocity Maintenance concept at Air Logistics Centers to reduce Program Depot Maintenance cycle times and cost. Pursued improvements in energy consumption required during manufacturing operations to reduce processing costs. Training responsibilities were transitioned to Air University to be utilized for Manufacturing Readiness Assessment (MRA) and Manufacturing Readiness Level (MRL) support.			
FY 2013 Plans: Continue efforts for cost effective development of conventional and low observable production and repair technologies enabling affordable sustainment of aircraft systems. Continue assessments and manufacturing technology development to reduce logistics support costs, lead times for high value supply chain commodities, and cycle times for depot repair. Provide subject matter			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603680F: *Manufacturing Technology Program*	PROJECT 635280: *Manufacturing Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
expertise in support of Manufacturing Readiness Assessments (MRAs) on Advanced Technology Demonstrations (ATDs), selected high-visibility technology programs and selected Air Force acquisition programs to aid in Milestone Decision Reviews and/or to mitigate cost/schedule issues. ***FY 2014 Plans:*** Continue development of cost effective conventional and low-observable production and repair technologies to enable affordable sustainment of aircraft systems. Continue assessments and manufacturing technology development to reduce logistics support costs, lead times, and cycle times for depot repair. Provide subject matter expertise in support of MRAs on ATDs, selected high-visibility technology programs and selected Air Force acquisition programs to aid in Milestone Decision Reviews for mitigation of cost, schedule and risk.			
Title: Advanced Manufacturing Technologies ***Description:*** Develop and transition pervasive affordability and producibility technologies for weapon systems and processes. ***FY 2012 Accomplishments:*** Continued development demonstration of rapid response and flexible manufacturing methods, commercial/military integration, quality processing, and supply stream improvements. Continued demonstration of manufacturing capabilities for more affordable low-observable structures, advanced propulsion technologies, electronics manufacturing technologies for Command, Control, Intelligence, Surveillance, and Reconnaissance (C2ISR), space, and advanced radar applications. ***FY 2013 Plans:*** Continue development demonstration of rapid response and flexible manufacturing methods, commercial/military integration, quality processing and supply stream improvements. Continue demonstration of manufacturing capabilities for more affordable low-observable structures, advanced propulsion technologies, electronics and optics manufacturing technologies for C2ISR, space solar cells, and advanced radar applications. ***FY 2014 Plans:*** Continue development and demonstration of next generation agile manufacturing methods, commercial/military integration, quality processing and supply chain improvements. Continue development and demonstration of manufacturing capabilities for more affordable and hot structures, advanced propulsion technologies, Air Force munitions, and electronics manufacturing technologies for communications, space solar cells, advanced Active Electronically Scanned Array (AESA) sensor applications, and Mid Wave Infrared optics. Initiate agile manufacturing risk reduction assessments on intelligence, surveillance, and reconnaissance components.	22.810	24.247	28.853
Accomplishments/Planned Programs Subtotals	38.275	37.045	41.353

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603680F: *Manufacturing Technology Program*	PROJECT 635280: *Manufacturing Technologies*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A.

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603680F: *Manufacturing Technology Program*	PROJECT 635281: *Manufacturing Readiness*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635281: *Manufacturing Readiness*	-	0.890	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Manufacturing Maturation	0.890	0.000	0.000
Description: Through application of MRAs, develop and implement manufacturing maturation plans to improve affordability and producibility and mitigate transition risk from development to production. ***FY 2012 Accomplishments:*** Completed development of Manufacturing Maturation Plans (MMPs) for Category I ATDs and selected high-visibility programs based on MRAs. Conducted MRAs on selected Air Force acquisition programs to aid in Milestone Decision Reviews and/or to mitigate cost, schedule, or rate issues. ***FY 2013 Plans:*** Manufacturing readiness work to continue under Manufacturing Technologies (BPAC 635280). ***FY 2014 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	0.890	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603680F: *Manufacturing Technology Program*	PROJECT 635281: *Manufacturing Readiness*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A.

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 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*					R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	36.944	31.419	49.093	-	49.093	39.693	38.203	40.839	40.332	Continuing	Continuing
635319: *Anticipatory OPS Intent and Response*	-	8.460	4.870	6.176	-	6.176	5.729	4.530	4.840	3.893	Continuing	Continuing
635320: *Assured Worldwide Connectivity*	-	11.223	13.103	21.485	-	21.485	15.468	14.340	16.165	16.123	Continuing	Continuing
635321: *Global Battlespace Awareness*	-	9.921	7.869	14.079	-	14.079	12.175	13.754	13.085	14.469	Continuing	Continuing
635322: *Knowledge Management and Computing*	-	7.340	5.577	7.353	-	7.353	6.321	5.579	6.749	5.847	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program develops and demonstrates Air Force enterprise-centric information technologies for the warfighter. 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 optical networks will be rapidly deployable, mobile, interoperable, and seamless between Air and Space Operations Centers (AOCs) and air- and space- based platforms either en route or in theater. This project also provides tools and applications leading to the development and integration of cyber deterrence technologies resulting in a strategic capability of cyber dominance within the secure information grid. The Knowledge Management and Computing project develops the technology applications that will provide for a secure, tailored, seamless exchange of information among producers, consumers, and managers of information relevant to a particular community of interest (COI). The project also provides the development of interactive and real-time computing technologies that greatly improve the usability of high performance computing for the exchange, utilization, and management of information in the enterprise. The Anticipatory Operations Intent and Response project develops the technologies for dynamic planning and execution with the accuracy, fidelity, and timeliness needed to dominate the battlespace. This program has been coordinated through the Department of Defense (DoD) Science and Technology (S&T)Executive Committee process to harmonize efforts and eliminate duplication. 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 2014 Air Force					DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*			R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*		
B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	38.628	31.419	48.093	-	48.093
Current President's Budget	36.944	31.419	49.093	-	49.093
Total Adjustments	-1.684	0.000	1.000	-	1.000
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	-0.734	0.000			
• SBIR/STTR Transfer	-0.950	0.000			
• Other Adjustments	0.000	0.000	1.000	-	1.000

Change Summary Explanation

Increase in FY 2014 is due to higher emphasis in anti-jam airborne communications.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635319: *Anticipatory OPS Intent and Response*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635319: *Anticipatory OPS Intent and Response*	-	8.460	4.870	6.176	-	6.176	5.729	4.530	4.840	3.893	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Distributed Information Technologies	0.956	0.000	0.000
Description: Develop and demonstrate distributed information technologies that are scalable and reconfigurable and provide seamless access to tailored multi-media and multi-spectral data. ***FY 2012 Accomplishments:*** Completed development of and demonstrated enhanced capability to conduct space command and control(C2). Completed campaign of experimentation to quantitatively measure transformational C2 concepts enabled by net centric warfare capabilities. Completed the investigation of space C2 planning and scheduling technologies to enable enhanced space operations. Completed development of an integrated C2 tasking capability to enable seamless full spectrum options to be reasoned over and recommendations provided to the operator that will meet commander's intent. ***FY 2013 Plans:*** N/A. Effort completed in FY12. ***FY 2014 Plans:*** N/A			
Title: Adaptive Planning and Decision Tools	3.345	3.265	2.470

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635319: *Anticipatory OPS Intent and Response*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: Develop and demonstrate the integration of planning tools and information-based intelligent agents for adaptive replanning and decision support tools. ***FY 2012 Accomplishments:*** Completed the investigation of methods to evaluate mobility courses of action (COA) covering planning through assessment that anticipates multiple constraints and provides prioritized feasible recommendations to meet commander's intent. Initiated development of net-centric mission planning and execution capabilities to support master space plan and joint space task order production and a net enabled dynamic decision support capability for a variety of air and space missions. ***FY 2013 Plans:*** Continue development of net-centric mission planning and execution capabilities to support a net-enabled dynamic decision support capability for a variety of air and space missions in support of global operations. Initiate design and development of a set of planning tools and services that proactively build and shape the portion of cyberspace employed in support of Mission Assurance (MA) objectives. ***FY 2014 Plans:*** Complete development and demonstration of cyber defense components that support Mission Aware Cyber C2. Continue development of net-centric mission planning and execution capabilities to support a net enabled dynamic decision support capability for a variety of air, space and cyber missions in support of global operations. Continue the design and development of a set of planning tools and services that proactively build and shape the portion of cyberspace employed in support of MA objectives.			
Title: Next Generation Planning and Assessment Tools ***Description:*** Develop and demonstrate an effects-based approach for the next generation of planning and assessment techniques that enable decision makers to determine operational effects. ***FY 2012 Accomplishments:*** Integrated and tested decision support environment, within service oriented architectures, that enable the decision maker to anticipate and shape all aspects of the future battlespace. Completed development of predictive battlespace planning tools with the ability to reason over models of the "enemy as a system." Conducted simulation experiments to analyze COAs and evaluate capabilities across multiple domains. Designed and conducted limited technology experiments to investigate the technical and operational challenges associated with integrated air, space, and cyber C2 within and across multiple service oriented architectures. Developed and demonstrated real-time information technologies that enable decision makers to comprehend their current situational awareness by assessing an operation's progress against desired effects and identifying key indicators and	4.159	1.605	3.706

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635319: *Anticipatory OPS Intent and Response*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
observables to assist in anticipating future success or failure of a campaign. Initiated integration of cascading COA reasoners. Initiated development of a toolset for predictive assessment, developing insight into action, causal mechanisms, and their effects. ***FY 2013 Plans:*** Continue an integration and test decision support environment, within service oriented architectures, that enables the decision-maker to anticipate and shape all aspects of the future battlespace. Continue designing and conducting limited technology experiments to investigate the technical and operational challenges associated with integrated air, space, and cyber C2 within and across multiple service oriented architectures. Continue the development and demonstration of real-time information technologies that enable decision-makers to comprehend their current situation by assessing an operation's progress against desired effects (reflective) and identifying key indicators and observables to assist in anticipating future success or failure of a campaign (predictive). ***FY 2014 Plans:*** Continue integration and test decision support environment, within service oriented architectures that enable the decision maker to anticipate and shape all aspects of the future battlespace. Increase efforts in the development and demonstration of real-time information technologies that enable a decision maker to comprehend their current situation by assessing an operation's progress against desired effects (reflective) and identifying key indicators and observables to assist in anticipating future success or failure of a campaign (predictive).			
Accomplishments/Planned Programs Subtotals	8.460	4.870	6.176

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635320: *Assured Worldwide Connectivity*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635320: *Assured Worldwide Connectivity*	-	11.223	13.103	21.485	-	21.485	15.468	14.340	16.165	16.123	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 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 provides enterprise networking capabilities for agile, policy-based network management. In addition, this project develops and demonstrates flight ready systems consisting of high capacity radio frequency (RF) and optical components and architectures for next generation communications. 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 cyber attack capabilities (access, stealth and persistence, cyber intelligence, and weapons delivery), cyber defense capabilities (attack detection, attack attribution, and response automation), and cyber support capability (situational awareness and war gaming.)

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Cyber Defense	2.502	0.000	0.000
Description: Proactively defend cyberspace through cyber situational awareness, detecting, and defeating cyber threats, and surviving through adaptation and self-generation.			
FY 2012 Accomplishments: Developed a capability to automatically discover large-scale network topologies to enhance cyber situation assessment and map the discovered topologies to mission essential functions. Completed the development of technologies that provide knowledge of the adversary to strengthen the quality of threat assessments. Developed a capability to integrate indications and warnings and observables into situation awareness and impact assessment capabilities. Completed assured end-to-end QoA and QoA integration to the information system enterprise during malicious and non-malicious faults.			
FY 2013 Plans: N/A. Effort completed in FY12.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635320: *Assured Worldwide Connectivity*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
N/A			
Title: Cyber Offense	3.070	3.825	4.368
Description: Develop and demonstrate offensive cyber operations capabilities in a series of Experimental Cyber Craft technology demonstrations. ***FY 2012 Accomplishments:*** Conducted experiments using testbed capability for in-house investigations of cyber defense policies and offensive cyber techniques to gain a better understanding of how an adversary might attack Air Force systems. Analyzed development of additional offensive cyber operations capabilities, integrated kinetic and cyber operations planning and execution capabilities, and Cyber C2 operations functions. ***FY 2013 Plans:*** Continue conducting experiments using testbed capability for in-house investigations of cyber defense policies and offensive cyber techniques to gain a better understanding of how an adversary might attack Air Force systems. Complete analysis of the development of additional offensive cyber operations capabilities, integrated kinetic and cyber operations planning and execution capabilities, and cyber C2 operations functions. Continue to develop and demonstrate capabilities that provide integrated cyber operations. ***FY 2014 Plans:*** Continue conducting experiments using testbed capability for in-house investigations of cyber defense policies and offensive cyber techniques to gain a better understanding of how an adversary might attack Air Force systems. Continue to develop and demonstrate capabilities that provide integrated cyber operations. Initiate development of next-generation cyber technologies to support Air Force missions.			
Title: Connectivity Technologies	0.783	0.998	5.141
Description: Develop and demonstrate intelligent networking transport and management technology to provide assured, seamless, battlespace connectivity to the Air Force tailored to anti-access/area denial environments and contested operations. ***FY 2012 Accomplishments:*** Initiated development of cognitive radio technology that will enable mission specific adaptive optimization of communications links responsive to current conditions, situations, and priorities as each mission is executed. Initiated advanced demonstration of end-to-end quality-of-service (QoS) and quality-of-assurance (QoA) performance for various application-dependent network configuration, management, and implementation scenarios. ***FY 2013 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635320: *Assured Worldwide Connectivity*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Complete development of cognitive radio technology that will enable mission specific adaptive optimization of communications links responsive to current conditions, situations, and priorities as each mission is executed. Continue advanced demonstration of end-to-end QoS and QoA performance for various application-dependent network configuration, management, and implementation scenarios. ***FY 2014 Plans:*** Demonstrate and transition a set of modular, foundational technologies required to develop an aerial layer secure tactical intranet. Continue advanced demonstration of end-to-end QoS and QoA performance for various application-dependent network configuration, management, and implementation scenarios. Initiate advanced demonstration of new technologies on an airborne testbed in support of creating an air-air/air-ground secure tactical intranet.			
Title: Resiliency ***Description:*** Integrate and demonstrate a resilient and self-regenerating information enterprise that dynamically recognizes, characterizes, and understands novel cyber attacks and reconfigures and self-optimizes to resist new attacks. ***FY 2012 Accomplishments:*** Integrated technologies to recognize, characterize, and understand attacks and anomalies, aid in the creation of synthetically diverse, functionally equivalent software, and continuously monitor, reconfigure, and self-optimize. Initiated developing techniques for guaranteeing the execution of critical processes during system recovery and data reconstitution. ***FY 2013 Plans:*** Continue integration technologies to recognize, characterize, and understand attacks and anomalies, aid in the creation of synthetically diverse, functionally equivalent software, and continuously monitor, reconfigure, and self-optimize. Continue developing techniques for guaranteeing the execution of critical processes during system recovery and data reconstitution. ***FY 2014 Plans:*** Complete demonstration of cyber defense applications against relevant strategic scenarios. Continue integration technologies to recognize, characterize, and understand attacks and anomalies, aid in the creation of synthetically diverse, functionally equivalent software, and continuously monitor, reconfigure, and self-optimize. Continue developing techniques for guaranteeing the execution of critical processes during system recovery and data reconstitution.	4.041	6.399	9.246
Title: Effects-based Cyber Defense ***Description:*** Integrate technology to demonstrate an effects-based strategic approach to cyber defense that focuses on avoiding, deterring, and minimizing the threat, and rendering the adversary ineffective. ***FY 2012 Accomplishments:***	0.572	0.188	1.833

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635320: *Assured Worldwide Connectivity*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Developed technologies to simulate a diverse set of active machines to thwart an adversary by transferring the attack to specialized nodes for analysis. Developed capability to automatically generate secure system/network configuration based on policy, architectural specifications, and operational requirements. ***FY 2013 Plans:*** Continue to develop technologies to simulate a diverse set of active machines to thwart an adversary by transferring the attack to specialized nodes for analysis. Continue development of capability to automatically generate secure system/network configuration based on policy, architectural specifications, and operational requirements. ***FY 2014 Plans:*** Continue to develop technologies to simulate a diverse set of active machines to thwart an adversary by transferring the attack to specialized nodes for analysis. Continue development of capability to automatically generate secure system/network configuration based on policy, architectural specifications, and operational requirements.			
Title: Airborne Communication Technologies ***Description:*** Develop and demonstrate flight ready systems consisting of high capacity RF and optical components and architectures for next generation communications. ***FY 2012 Accomplishments:*** Developed and demonstrated a directional networking prototype for tactical data links. ***FY 2013 Plans:*** Initiate development of V/W band (50 GHz to 110 GHz) airborne communications components. Initiate flight demonstration of communications systems for use in contested environments. ***FY 2014 Plans:*** Continue development of V/W band airborne communications components. Continue flight demonstration of communications systems for use in contested environments.	0.255	1.693	0.897
Accomplishments/Planned Programs Subtotals	11.223	13.103	21.485

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635320: *Assured Worldwide Connectivity*

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635321: *Global Battlespace Awareness*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635321: *Global Battlespace Awareness*	-	9.921	7.869	14.079	-	14.079	12.175	13.754	13.085	14.469	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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, such as intelligence, surveillance, and reconnaissance (ISR) 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-and-dimensional representation of the battlespace; assessing the situation; predicting adversary 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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Advanced Signal and Data Exploitation Technologies	2.412	1.332	2.925
Description: Demonstrate advanced signal and data exploitation technologies for detection, tracking, identification, and targeting of time-critical targets, and information extraction.			
FY 2012 Accomplishments: Completed development of enhanced signal processing techniques to fit into existing ISR infrastructures. Completed the development of a set of algorithms that can automatically track space objects in support of space situational awareness (SSA). Conducted both the integration of developed watermarking techniques and protocols for information assurance, provenance, and pedigree leading to the integration of watermarking technologies into network-centric programs of record. Developed novel steganalysis methods for identifying and disrupting embedded information.			
FY 2013 Plans: Continue both the integration of developed watermarking techniques and protocols for information assurance, provenance, and pedigree leading to the integration of watermarking technologies into network-centric programs of record, and the development of novel steganalysis methods for identifying and disrupting embedded information.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635321: *Global Battlespace Awareness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue both the integration of developed watermarking techniques and protocols for information assurance, provenance and pedigree leading to the integration of watermarking technologies into network-centric programs of record, and the development of novel steganalysis methods for identifying and disrupting embedded information. Deliver capabilities to increase analyst production by integrating and enhancing multi-intelligence exploitation within the Distributed Common Ground Station. Enable semi-automated data-sharing across multiple security enclaves with intelligent data tagging. Provide automated extraction of motion-derived linkages/routes and network relationships.			
Title: Advanced Data Handling, Visualization and Distributed Data Fusion ***Description:*** Develop and demonstrate advanced data handling, event visualization technologies, and distributed data fusion to enable a more effective utilization of data available. ***FY 2012 Accomplishments:*** Matured and integrated models for adversarial behavior and provided support for situation analysis utilizing a service oriented architecture. Developed algorithmic tools and techniques to analyze and exploit recorded signals intelligence data across multiple missions, to provide the capability for forensic analysis of single or multi-platform data across multiple missions for increased situational awareness and intelligence. ***FY 2013 Plans:*** Complete development to mature and integrate models for adversarial behavior and provide support for situation analysis utilizing a service oriented architecture. Complete development of algorithmic tools and techniques to analyze and exploit recorded signals intelligence data across multiple missions, to provide the capability for forensic analysis of single or multi-platform data across multiple missions for increased situational awareness and intelligence. Initiate development of a prototype for the fusion of information (temporally and geospatially) from multiple exploitation domains to create a comprehensive understanding of the battlespace. ***FY 2014 Plans:*** Continue development of a prototype for the fusion of information (temporally and geospatially) from multiple exploitation domains to create a comprehensive understanding of the battlespace. Initiate a learning and inferencing architecture that operates on raw sensor data from heterogeneous sensors in order to determine an automated situational awareness picture.	3.662	1.743	4.131
Title: Autonomous Text Exploitation ***Description:*** Develop and demonstrate capabilities for reasoning and learning, text understanding, link and group discovery, and advanced analysis for situational awareness and understanding. ***FY 2012 Accomplishments:***	0.471	0.879	0.843

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635321: *Global Battlespace Awareness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Developed a text extraction capability that enables users to fine-tune the extractor, based on their specialized knowledge of the domain, to achieve higher performance. Completed development of tools and services for advanced behavioral modeling techniques and advanced capabilities for analysis that integrate situation understanding, situation monitoring, and event anticipation. Initiated exploration of general purpose bridges between the corpus of electronic text and formal reasoning systems. Developed dynamic social network analysis methods to provide the analyst with the ability to identify high value targets in social networks and anticipate their role and activity. Completed development of a set of algorithms that can automatically develop, reason, dynamically update various sub-sets of the existing intelligence preparation of the battlespace products, and continue development of techniques for analyzing and assessing activities to support situation assessment. ***FY 2013 Plans:*** Continue exploring general purpose bridges between the corpus of electronic text and formal reasoning systems. Complete development of dynamic social network analysis methods to provide the analyst with the ability to identify high value targets in social networks and anticipate their role and activity. ***FY 2014 Plans:*** Continue exploring general purpose bridges between the corpus of electronic text and formal reasoning systems. Develop capabilities enabling analysts to efficiently extract/consolidate information from massive amounts of textual data and identify enemy entity-relation. Increase the accuracy and speed of cross-document entity co-reference and consolidation. Initiate demonstration of analysis and visualization of multi-layered networks consisting of diverse data sets.			
Title: Adversary Courses of Action	3.376	3.915	6.180
Description: Develop models to provide detailed understanding of the adversary's probable intent and future strategy to identify adversary COAs, the most likely COA, and the COA most dangerous to friendly forces and mission accomplishment. ***FY 2012 Accomplishments:*** Developed a functional graphical user environment to support output analysis and conducted investigations in developing screening techniques that give the analyst/decision-maker insight into the contribution or sensitivity of various factors on a given observable/response. Used scenarios and conducted user testing and feedback of models for new regions and nations. Completed investigation of the capability to manage multiple possible future adversary COAs prioritized based on current and future (projected) impact/threat. Developed a capability to model and explore policy actions and reactions taken by the different modeled entities, and started developing the capability to allow users to perform automated generation, assessment, and visualization of traces from model results to key underlying causes. Developed and demonstrated robust support applications to enhance multi-intelligence collection requirements. ***FY 2013 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635321: *Global Battlespace Awareness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue development of a functional graphical user environment to support output analysis and complete investigations in developing screening techniques that give the analyst/decision-maker insight into the contribution or sensitivity of various factors on a given observable/response. Use scenarios and conduct user testing and feedback of models for new regions and nations. Continue developing capability to model and explore policy actions and reactions taken by the different modeled entities, and start developing the capability to allow users to perform automated generation, assessment, and visualization of traces from model results to key underlying causes. Initiate development of tools to increase awareness of alternatives and ramifications of selecting given target sets. Initiate development of exploitation and analysis tools to automate target recognition and tracking. ***FY 2014 Plans:*** Continue development of a functional graphical user environment to support output analysis and complete investigations in developing screening techniques that give the analyst/decision-maker insight into the contribution or sensitivity of various factors on a given observable/response. Use scenarios and conduct user testing and feedback of models for new regions and nations. Initiate demonstration of advanced analytical capabilities that integrate kinetic and non-kinetic options for full spectrum targeting. Initiate development of assessment technologies that identify causal linkages of executing mission results to achievement of effects. Increase targeting capabilities to include the full range of options available to increase the depth and breadth of the analysis and reduce the overall time to perform analyses and generate targeting options. Enable assessment of kinetic/non-kinetic effects across the targeting process.			
Accomplishments/Planned Programs Subtotals	9.921	7.869	14.079

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635322: *Knowledge Management and Computing*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
635322: *Knowledge Management and Computing*	-	7.340	5.577	7.353	-	7.353	6.321	5.579	6.749	5.847	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Game Changing Computing Power	1.201	0.559	0.000
Description: Develop and demonstrate computer architectures with greater capacity and sophistication to enable game changing computing power to the warfighter, anywhere, anytime.			
FY 2012 Accomplishments: Developed petaflops embedded on-demand computing, and demonstrated achieved performance and functionality. Initiated development of architectures for a compact large array of many node clusters with very low power demand for intelligent systems. Initiated development and demonstration of an autocode generation capability for software intensive systems. Completed development of comprehensive software and hardware solutions for parallel discrete event simulation on emerging multi-core architectures.			
FY 2013 Plans: Complete the development of petaflops embedded on-demand computing, and demonstrate achieved performance and functionality. Continue development of architectures for a compact large array of many node clusters with very low power demand			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603788F: *Battlespace Knowledge Development and Demonstration*	PROJECT 635322: *Knowledge Management and Computing*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
for intelligent systems. Continue development and demonstration of an autocode generation capability for software intensive systems. ***FY 2014 Plans:*** Due to technology maturity, the development of architectures for a compact large array of many node clusters with very low power demand and the development of an autocode generation capability for software intensive systems has been reverted back to applied research (6.2) in PE 0602788F, Project 625316.			
Title: Advanced Information Management ***Description:*** Demonstrate how a publish, subscribe, and query information management paradigm can enable vertical and horizontal integration of Air Force information systems. ***FY 2012 Accomplishments:*** Completed development of an adaptive security policy expression and enforcement mechanism for automated information review and release among different security domains. Completed developments of secure, accreditable cross domain information sharing techniques in an operational setting and of a scalable integrated environment where information is easily and securely shared across multiple secure domains while preventing accidental or intentional information disclosure. Initiated development of attack resistant cross domain services. ***FY 2013 Plans:*** Continue development of attack resistant cross domain services. ***FY 2014 Plans:*** Continue development of attack resistant cross domain services. Deliver a suite of new U.S./coalition collaboration services, producing cross-domain capabilities including voice/video, full motion video (FMV) streaming, automated content inspection, and global trusted remote management. Create Secure Cross Domain Video Teleconference capability.	0.534	0.721	1.713
Title: Agile Information Management Services ***Description:*** Demonstrate how agile information management services enable effective information sharing in a tactical environment. ***FY 2012 Accomplishments:*** Developed tactical information management pub/sub/query mechanisms focusing on stability, performance, and reliability for assured access and isolation from malicious client applications, and assured levels of QoS. Initiated design and development of a mission oriented, highly adaptive and self-aware unified intelligent capability to provide observable, actionable insights and visibility across information management services and their deployed platforms from inside-out and provide survivability-aware	5.605	4.297	5.640

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
information sharing capabilities to anticipate achieving the information level mission goals under any conditions. Investigated and quantifyied the network burden and quality of service requirements for service oriented architecture implementations across a variety of tactical environments. Developed survivable information management (IM) services that are highly adaptive and self-aware across the variety of IM architectures. ***FY 2013 Plans:*** Complete development of tactical information management publish/subscribe/query mechanisms focusing on stability, performance, and reliability for assured access and isolation from malicious client applications, and assured levels of QoS. Continue design and development of a mission-oriented, highly adaptive and self-aware unified intelligent capability to provide observable, actionable insights and visibility across information management services and their deployed platforms from inside-out and provide survivability-aware information sharing capabilities to anticipate achieving the information level mission goals under any conditions. Continue investigating and quantifying the network burden and QoS requirements for service oriented architecture implementations across a variety of tactical environments. Continue to develop information management capabilities in support of force protection. ***FY 2014 Plans:*** Complete development of survivability-aware information sharing capabilities. Demonstrate a capability to link information flows to missions, providing the mission context for mission-driven sense and respond IM services. Continue investigating and quantifying the network burden and quality of service requirements for service oriented architecture implementations across a variety of tactical environments. Continue to develop IM capabilities in support of force protection. Continue design, development and demonstration of mission-oriented, highly adaptive information management technologies. Demonstrate IM services embedded with sensor platforms, such as targeting pods, to quickly and affordably link pilots, remotely-piloted vehicles (RPVs), and ground personnel for improved situation awareness. Continue to develop resource-aware IM services that are responsive to the information needs of high priority missions and users, respond to resource availability changes in contested/degraded environments, minimize information overload and dissemination latency, and improve situational understanding for missions, allowing commanders to make more timely and informed decisions.			
Accomplishments/Planned Programs Subtotals	7.340	5.577	7.353

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
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E. Performance Metrics

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

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*					R-1 ITEM NOMENCLATURE PE 0603924F: *High Energy Laser Advanced Technology Program*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	1.088	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
635095: *High Energy Laser Advanced Technology Program*	-	1.088	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program funds Department of Defense (DoD) high energy laser (HEL) advanced technology development through the HEL Joint Technology Office (JTO). This program is part of the overall DoD HEL Science and Technology (S&T) program. 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 defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles and the ultra-precision negation of targets in urban environments with minimal collateral damage. Efforts in this program have been coordinated through the DoD S&T Executive Committee process to harmonize efforts and eliminate duplication. This program is in Budget Activity 3, Advanced Technology Development, since it enables and demonstrates HEL capabilities and concepts.

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	1.122	0.000	0.000	-	0.000
Current President's Budget	1.088	0.000	0.000	-	0.000
Total Adjustments	-0.034	0.000	0.000	-	0.000
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-0.034	0.000			
• Other Adjustments	0.000	0.000	0.000	-	0.000

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Solid State Laser Technologies	1.088	0.000	0.000
Description: Advance solid state laser development. Develop beam-control technologies for surface and air mission areas.			
FY 2012 Accomplishments:			

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603924F: *High Energy Laser Advanced Technology Program*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Completed integrated systems field tests at High Energy Laser Systems Test Facility (HELSTF). Demonstrated solid-state laser capability with adaptive optics beam control architecture in a field environment against selected targets. ***FY 2013 Plans:*** N/A ***FY 2014 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	1.088	0.000	0.000

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A

F. 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.